Mariners Weather Log

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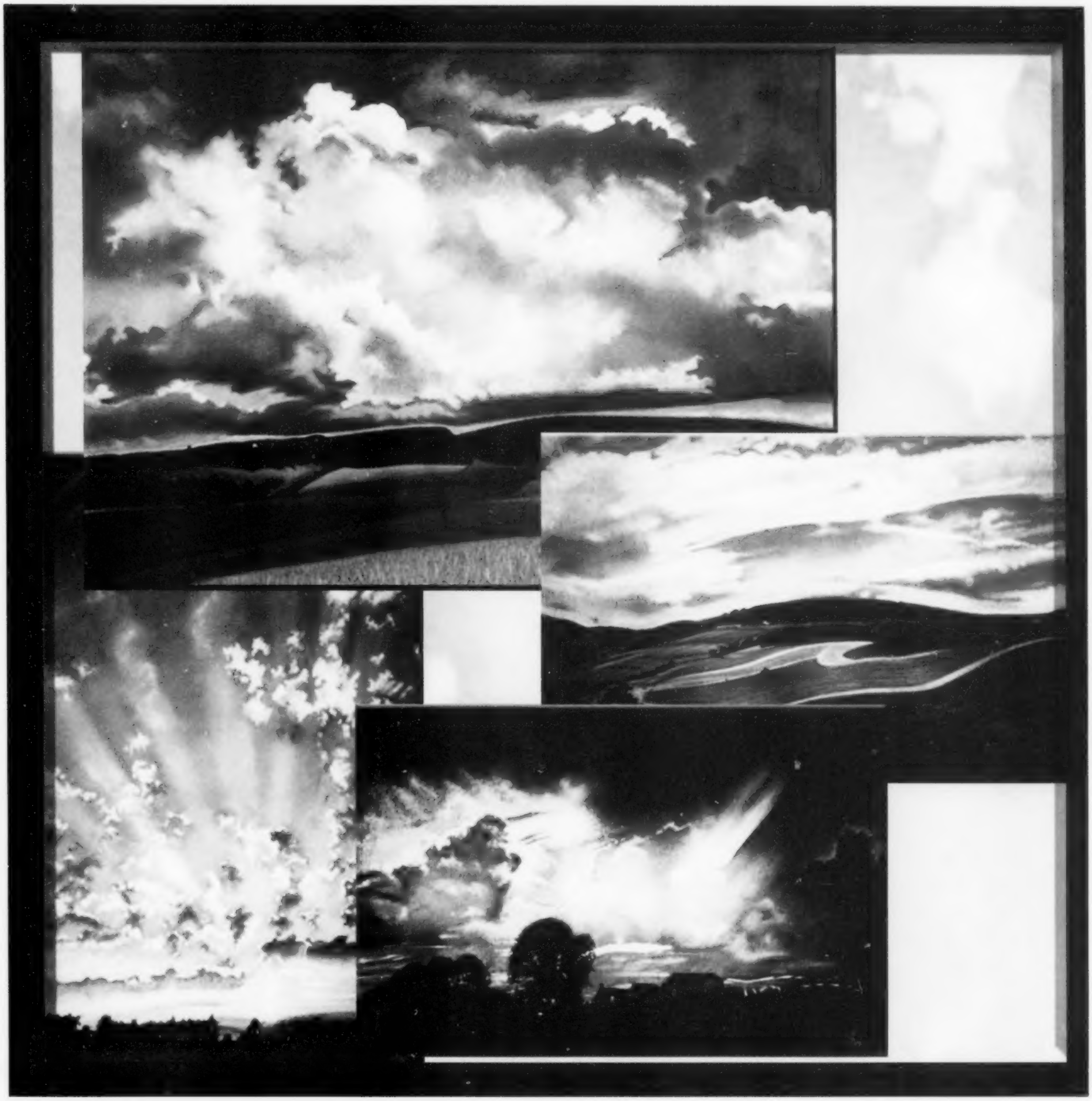

The cover artwork is courtesy of Richard Dewar, a retired architect from Scotland. Since his retirement, he has pursued painting and photographing clouds.

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From the Editorial Supervisor

Welcome once again to another offering of the Mariners Weather Log (MWL). I hope that this issue finds you healthy, happy, and where you want to be in life. Of course, for most of us, that would be anywhere with the salt spray in our faces and the trade winds frolicking through our hair (ok, what is left of it that is…). The VOS program has been really active since we last chatted. It was hard last year to make the decision about cutting back the number of MWLs issued per year. It was purely a budgetary decision and not meant to show any lack of support or commitment to this great publication or its reading audience. After several financial discussions (yes, the wounds do heal in time), the VOS program has found a way to rub its pennies together to make it work. So, beginning this next fiscal year, the MWL will return to being published three (3) times per year. We will revert back to a December, April and August issue. I humbly apologize for any and all inconvenience this has caused all of you.

I hope you enjoy this issue, which includes great features such as: Admiral Kreüger's anemometer, the heroic efforts of the **Meredith Victory**, some great artwork from Scotland, and an article from the Tropical Prediction Center (TPC) on how vital YOUR VOS observations really are!

After our last issue, George Smith, the PMO in Cleveland, retired from government service. George didn't want a lot of fanfare so there will not be an article about his life, but ***Thank you, Friend,*** for nearly 43 years of Federal service.

In the last issue, I mistakenly said that Ms. Debra Russell, the new Alaskan PMO, was in Kodiak. Whoops! Deb actually works in Valdez. It must be this hot Mississippi sun that has fried my brain to cause this confusion between Deb & Rich Courtney. Or maybe it was too many years of cold coffee on the 00-04 watch that did it. Sorry Deb!!! (Guess I'd better get my eyes checked again.)

So, as long as you are off watch, go find a snug harbor to prop up your feet, grab some coffee, and enjoy the MWL.

Regards - *Luke* ⚓

Some Important Web Page Addresses

NOAA	http://www.noaa.gov
National Weather Service	http://www.nws.noaa.gov
National Data Buoy Center	http://www.ndbc.noaa.gov
AMVER Program	http://www.amver.com
VOS Program	http://www.vos.noaa.gov
SEAS Program	http://seas.nos.noaa.gov/seas/
Mariners Weather Log	http://www.nws.noaa.gov/om/mwl/mwl.htm
Marine Dissemination	http://www.nws.noaa.gov/om/marine/home.htm
U.S. Coast Guard Navigation Center	http://www.navcen.uscg.gov/marcomms/

See these Web pages for further links.

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Admiral Johan Henrik Kreüger and his Anemometer

Tage Anderson
Swedish Meteorological Society

The weather services of today were founded during the latter part of the 19th century, and much of the necessary preparatory work was performed by seamen. For example, although the 1806 wind scale of Admiral Beaufort was not the first one, it won general acceptance and still is used. It was first used by the captain of the **Beagle**, Robert FitzRoy, on his circumnavigation of the globe with Chales Darwin as naturalist. In 1854, FitzRoy founded the department of the Board of Trade, which later became the Meteorological Office. In 1861, he established a network of telegraphing meteorological stations and began reporting gale warnings and weather forecasts (a term he coined) to the public. His big "*Weather Book*" from 1863 shows our storms and cyclones as waves on the border between warm tropical and cold polar air.

In the 1840's, Captain Piddington introduced the notion of 'cyclone', and U.S. Admiral Maury's charts of the winds and currents of the major oceans in "*Wind and Current Charts* (1847)" revolutionized shipping. He also initialized the first international conference in oceanography, meteorology and navigation in Brussels in 1853.

Around 1850, Johan Henrik Kreüger, a weather-minded Swedish admiral, designed an anemometer. This instrument was used in the first Swedish network of meteorological observations, which was established by the Swedish Pilotage Service around 1850. The network consisted of about 20 stations on Swedish beacons. The initiative came from the Royal Swedish Academy of Science (Erdmann 1855), and the primary purpose of the network was to study the postglacial land rise[1].

	Wind pressure	Wind speed
Lab. Bram-segels Kultje	½	20
Bram-Segels Kultje	1	28.5
Frisk Bram-Segels Kultje	1½	35.5
Märssegels Kultje	2	41
Styf Mers-Segels Kultje	2½	46
Refvad Märs-Segels Kultje	3	50
Styf refv. Märs-Seg. Kultje	4	58
Under-Segels Kultje	5	65
Half Storm	7 à 8	79
Full Storm	10à12	96
Orkaner	20	130
Den starkaste Orkan som blifvit utrönt	30	159

Table 1. The Swedish wind scale from 1779. Wind pressure in skålpund per Swedish square foot, wind speed in Swedish feet per second. 1 Swedish foot = 29.7 cm, 1 skålpund = 0.4251 kg. After Kreüger (1841).

Johan Henrik Kreüger was borne in Lovisa, Finland, 1782. His parents were the Customs Collector Johan Kreüger and wife Anna Cederhvarf. Though they did not belong to the nobility, at the age of 10 years Johan Henrik was appointed Sergeant in the Army's Fleet of Sveaborg. After having passed his examination as a naval officer as well as his examination in naval architecture, he was appointed Second Lieutenant in 1801. Most of the following 20 years he spent at sea, on warships and merchant ships. In 1812 he was appointed captain and sailed merchant ships to the Mediterranean and South America. During the Napoleonic war, he commanded warships. He was appointed Commander Captain in 1824, and the following year he became a member of '*Förvaltningen av sjöärendena*'[2]. He became head of the organization in 1841, when he was appointed Rear Admiral. He obtained the rank of Vice Admiral in 1850 and of Admiral in 1857. He became a member of the Royal Swedish Academy of War Sciences in 1817 and of the Royal Swedish Academy of Sciences in 1857, the year before his death.

After his time at sea, Kreüger became a diligent author on various subjects, such as naval history, present nautical and defence problems, and weapon development. In 1841, he gave a talk at the Royal Academy of War Science, '*Om Luften, dess rörelse eller Vindarne, samt orsakerna dertil*' ('About the Air, its Movements or the Winds and their causes'). In this speech he revealed his mastery of the meteorology of his time. He believed that the atmosphere could reach up to 90 km, and he knew that the air consists of 21 parts of oxygen and 79 parts of nitrogen. He was familiar

[1] 1858 the Academy started the first Swedish network for purely meteorological and climatological purposes, which 1859 had 21 stations and should increase to 30 stations.

[2] This government office managed the finances of the Navy and the lighthouses.

with the then new works of Redfield and Reid and knew that the devastating tropical storms (which we call tropical hurricanes) are rotating storms (anti-clock-wise in the northern hemisphere), and that although their wind speeds are very high, the systems themselves move much slower (10 to 30 nautical miles per hour). He knew their order of size and that the rotating tornadoes are much smaller. He also indicated that the storms of our latitudes may be rotating storms, perhaps originating in the West Indies. Later, data from his anemometer network convinced him that our storms are rotating (Kreüger 1855, 1857).

An early Swedish wind scale

In 1779, a Swedish wind scale was developed during tests with a new Swedish 60 gunship (Kreüger 1841). The ship had an anemometer, a hand-held pressure plate of the type designed by Bouger (Middleton, 1969). In several cases the wind pressure was measured, and for each case the proper name of the wind was decided after discussion with all the officers. The scale is given in ***Table 1***. The corresponding wind speeds were later calculated by Kreüger, (though he wrote that he could not guarantee their accuracy).

The Anemometer of Kreüger

The pressure plate ***h***, supported by two pairs of friction wheels, can move in a frame fastened to the wind vane ***g***, ***Figure 1*** (Erdmann, 1855). The axis of the vane is a tube (Kreüger suggests a musket pipe). With a cord running in the tube, the pressure plate is connected to a lever with a scale and a counterweight ***o***. Two clicks ***q*** lock the scale and counterweight at the maximum indication. The instrument thus records the maximum wind pressure since last release of the clicks. After the first tests, the vane was equipped with a V-shaped fin to dampen its oscillations.

The sensors should be placed on the lighthouse master's house with the wind vane at the height of the chimney, and with the lever and the scale in the attic. A 32-point wind rose on the tube (not shown in ***Figure 1***) showed the wind direction. The instrument also had a primitive recording device (not shown in ***Figure 1***), a piece of chalk on the lever writing on a circular plate. A pendulum clockwork rotated the plate. This device was probably not used.

The anemometer took part in the world's exhibitions in London in 1851 and in Paris in 1855. In both of them, it won a medal. After a correspondence in which the Swedish King Oskar I took part, the instrument from the Paris exhibition was given to the French marine minister.

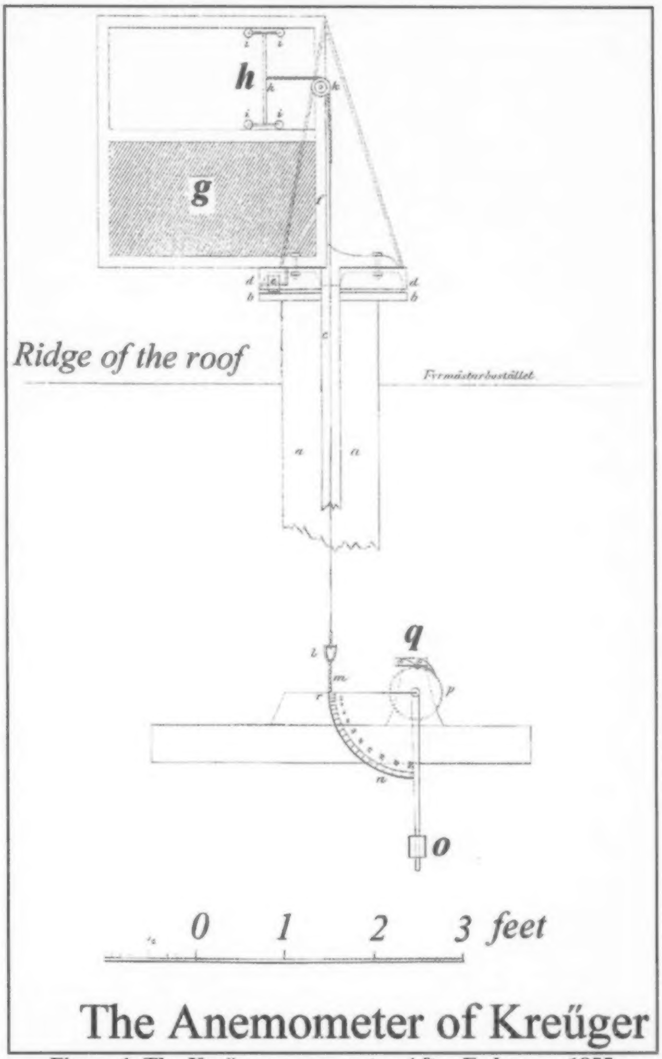

Figure 1. The Kreüger anemometer. After Erdmann, 1855.

A multitude of meteorological instruments were designed during the 18th and 19th centuries. Few of them were actually built and even fewer reached operational status. One of these is an anemometer created by the Swedish admiral Kreüger around 1850. It was used in the first Swedish network of meteorological stations, created about 1850. The main purpose of the network was to study the postglacial land rise, through several people, amongst them Kreüger himself, realised its possibilities.

In the early 1850's, the instrument was installed on nine Swedish beacons and on Kastellholmen, Stockholm, as well as on Kungsholm's fortress, Karlskrona. The observations were made three times a day, more often if the wind pressure exceeded a certain limit. A drawing from the latter half of the 19th century shows the anemometer at Holmögadd, ***Figure 2***. The anemometer was used nearly 30 years. After a reorganisation in 1879, a new government office, 'Nautisk-Meteorologiska Byrån', took over the lighthouses, and the Kreüger anemometers were scrapped. They were replaced by a handheld manometer, the Hagemann's anemometer. This did not improve the wind observations; in fact they soon got worse, and the Hagemann anemometer was abandoned after about 20 years (Östman, 1928).

When the power of the wind is wanted, the wind pressure, not the wind speed, is the important parameter. Kreüger stressed the uncertainty in deducing the wind pressure from rotation anemometers. Kreüger's wind gauge and Robinson's cup anemometer were designed at about the same time, with Robinson's being designed somewhat earlier. The cup anemometer is a mechanically much simpler and more elegant instrument, and Kreüger's pressure plate anemometer could not compete with it. However, his wind gauge was used for nearly 30 years in one of the earliest meteorological networks with anemometers. The lighthouses' meteorological journals from that period are stored in the archive of the Swedish Meteorological and Hydrological Institute.

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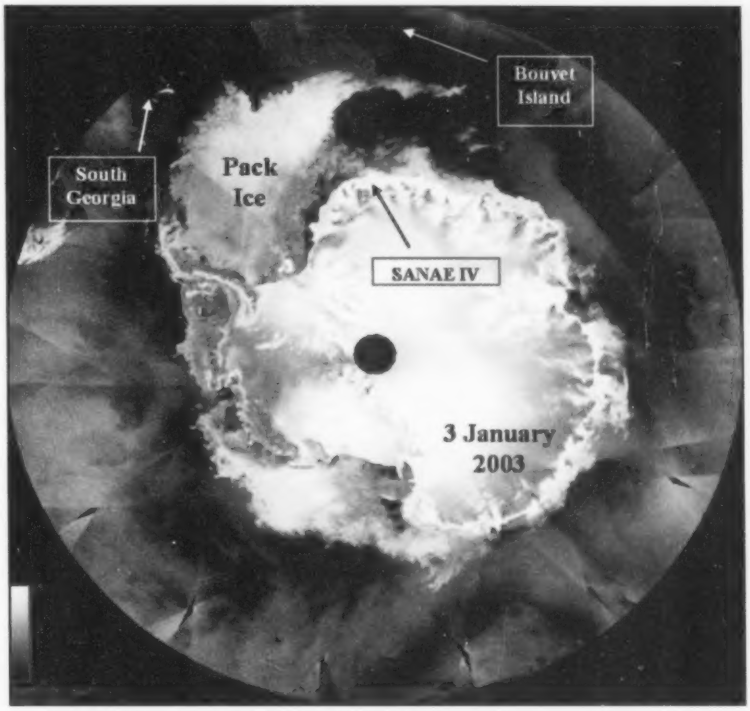
Figure 2: Holmögadd, latter part of the 19th century. Part from a drawing of an unknown artist. The anemometer is mounted on the roof of the lighthouse master's house, between the lighthouse and the flagstaff. A ladder against the gable is used to reach the attic and read the instrument. Observations were made 3 times each day, more often during high wind speeds. After Hedin, 1988.

SA Agulhas Deploys Drifting Weather Buoys

Ian Hunter, Manager
Maritime Services, South African Weather Service

The satellite image shown on the right comes courtesy of the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA). It is a composite of all of the passes of the QuikSCAT satellite over the south pole over a 24 hour period, with the onboard SeaWinds Scatterometer providing information on both sea surface wind conditions and ice cover.



The South African polar relief vessel **SA Agulhas**, having offloaded cargo and personnel for the SANAE IV Antarctic base at Vesleskarvet, is now on a circular voyage which will take her around South Georgia and back to SANAE via the southernmost island of the South Sandwich Island chain, South Thule.

The sole purpose of this trip is to deploy several drifting weather buoys and to replace the automatic weather station on South Thule Island. The buoys form an extremely important component of the global network of meteorological data-gathering platforms. Their information is relayed via the ARGOS satellite data collection system to various receiving stations, and from there into numerical weather prediction models run by national meteorological services all around the world.

On New Year's Day, the *SA Agulhas* sailed through the last of the pack ice arching eastwards south of Bouvet Island.

Without drifting weather buoys there would be no information over vast areas of the Southern Ocean, such as in the huge area between South Georgia, Bouvet Island and Gough Island, where much of the heavy swell affecting the southern African coastline is generated.

On New Year's Day, the **SA Agulhas** sailed through the last of the pack ice arching eastwards south of Bouvet Island. She is now in open water heading WNW and deploying the weather buoys en route.

Three large icebergs are faintly visible on this radar image, ranged around South Georgia. The original iceberg (A38) was calved from the Ronne Ice Shelf, 3000 kms to the south, in October 1998. ⚓

NOAA Extends Hurricane Forecasts from Three to Five Days; Additional Planning Time Critical for U.S. Navy and Others

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The NOAA National Weather Service will begin issuing five-day hurricane forecasts this year, extending the three-day forecasts issued since 1964. NOAA is charged with protecting life and property against tropical cyclones by issuing timely and accurate hurricane forecasts, watches and warnings. The agency is extending the forecasts after a two-year test. The agency cited customer needs for longer-range forecasts and major improvements in track forecasting skill over the past few decades as reasons for lengthening the forecasts.

View of Hurricane Lili taken at 4:45 p.m. EDT on Oct. 2, 2002.

According to James R. Mahoney, Ph.D., Assistant Secretary of Commerce for Oceans and Atmosphere and NOAA Deputy Administrator, "This five-day forecast provides a valuable planning and preparedness tool, and is a tangible step forward in our efforts to protect lives and property and enhance the U.S. economy. The new forecast is particularly useful for those who need more than 72 hours advance notice to move resources out of harms way, such as U.S. Navy ships. Furthermore, as people and infrastructure crowd coastal areas, earlier awareness to a potential problem is needed to increase public safety."

Captain Jeff Bacon, Commander, Naval Atlantic Meteorology and Oceanography Center, Norfolk, Va., said, "U.S. Navy interest in the longer range forecasts are driven by the lengthy time required to protect major shore activities, move ships from port, or divert those at sea. Decision timelines often extend beyond four days in advance of the onset of destructive conditions."

Max Mayfield, NOAA's National Hurricane Center Director, said, "NHC and the Central Pacific Hurricane Center have been working closely with our customers since 1999 to extend the forecasts, and went through a rigorous set of experiments during the 2001 and 2002 Atlantic and eastern and central North Pacific hurricane seasons to test this capability. These experiments were successful largely because of improved modeling techniques developed jointly by the NOAA Geophysical Fluid Dynamics Laboratory, Environmental Modeling Center and other researchers." Data from the 2001 and 2002 seasons indicate the five-day track forecast will be as accurate as the three-day forecast was 15 years ago.

Accuracy in hurricane track forecasting is measured by "track error"—the distance between the predicted position of a storm's center and its later, actual position. The two year trial showed the five-day average track error for Atlantic tropical storms and hurricanes was 323 nautical miles (nm), and 191 nm in the eastern Pacific. For comparison, in 1964-1965, the first two years of three-day Atlantic track forecasts, average error was 389 nm. Pacific errors are typically lower because many of the storms move generally east to west. While Atlantic storms often track east to west too, many curve toward the northwest and north and often accelerate, making them more difficult to forecast.

NOAA's National Weather Service is the primary source of weather data, forecasts and warnings for the United States and its territories. NOAA National Weather Service operates the most advanced weather and flood warning and forecast system in the world, helping to protect lives and property and enhance the national economy.

NOAA is dedicated to enhancing economic security and national safety through the prediction and research of weather and climate-related events and providing environmental stewardship of the nation's coastal and marine resources. NOAA is part of the U. S. Department of Commerce.

Relevant Web Sites for Hurricane Information

2002 Atlantic Hurricane Season Summary: http://www.nhc.noaa.gov/2002atlan_summary.shtml

NOAA National Hurricane Center — Get the latest advisories here: http://www.nhc.noaa.gov/

NOAA Atlantic Hurricanes Database — 150 Years of Atlantic Hurricanes: http://hurricane.csc.noaa.gov/hurricanes/

Saffir-Simpson Hurricane Scale: http://www.nhc.noaa.gov/aboutsshs.shtml

NOAA Satellite Images — The latest satellite views: http://www.goes.noaa.gov/

Colorized Satellite Images: http://www.goes.noaa.gov/enhanced.html

NOAA 3-D Satellite Images: http://www.nnvl.noaa.gov/

NOAA Hurricanes Page: http://hurricanes.noaa.gov/

Media Contact: ***Frank Lepore***, *NOAA National Hurricane Center, (305) 229-4404*

Ground Breaking Held for New Maritime Center

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In a historic step toward better preserving and managing our nation's maritime heritage, NOAA broke ground at its new Maritime Archaeology Center at The Mariners' Museum in Newport News, Va. The groundbreaking was attended by NOAA's Deputy Under Secretary Scott B. Gudes, Rep. Jo Ann Davis (R-Va.), Rep. Bobby Scott, (D-Va.), and The Mariners' Museum President and CEO John Hightower.

"NOAA's Maritime Archaeology Center will serve as the coordination point for the protection of cultural resources within our National Marine Sanctuaries," said Gudes. "Since the Monitor National Marine Sanctuary was designated the first National Marine Sanctuary in 1975, NOAA has been charged with the protection of historic shipwrecks and other submerged archaeological sites. By breaking ground today, we are taking a vital step toward strengthening NOAA's commitment to protecting these unique and irreplaceable underwater resources." ⚓

Breaking ground for the new Center are: (left to right) John Hightower, President of the Mariners' Museum; Rep. Bobby Scott; Dan Basta, Director - NOAA's National Marine Sanctuary Program; Scott Gudes, Deputy Under Secretary of Commerce; Rep. Jo Ann Davis; Joe Frank, Mayor, Newport News, VA.

Nowcasting the Wind Speed During a Hurricane at Sea

Professor S. A. Hsu, Louisiana State University

Nowcasting is a description of current weather and a short-term forecast varying from minutes to a few hours (see Greer, 1996). During a hurricane, nowcasting is needed to supplement the "official" forecast by the National Weather Service to steer the ship away from the danger imposed by the storm. Nowcasting of the wind speed is a way to avoid the danger. The methodology is as follows.

According to Anthes (1982, p. 22 and Fig. 2.8),

$$U_{10\gamma} = U_{10\,max}\left(\frac{R}{\gamma}\right)^{0.5} \qquad (1)$$

where $\mathbf{U_{10\gamma}}$ is the sustained wind speed at 10 m at a distance away from the storm center, and $\mathbf{U_{10\,max}}$ is the maximum sustained wind speed at 10 m at the radius of maximum wind, **R**.

According to Hsu et al. (2000), for operational applications,

$$\frac{R}{\gamma} = \ln\left(\frac{1013 - P_0}{P_\gamma - P_0}\right) \qquad (2)$$

where $\mathbf{P_0}$ is the minimal sea-level or central pressure of the hurricane, $\mathbf{P_\gamma}$ is the pressure at a point located at a distance from the storm center, and **ln** is the natural logarithm.

Substituting Equation (2) into (1), we have

$$U_{10\gamma} = U_{10\,max}\left[\ln\left(\frac{1013 - P_0}{P_\gamma - P_0}\right)\right]^{0.5} \qquad (3)$$

According to Hsu (2003, this issue),

$$U_{10\,max} = 6.3\left(1013 - P_0\right)^{0.5} \qquad (4)$$

Therefore, $\mathbf{U_{10\gamma}}$ can be nowcasted by Equations (3) and (4) using only a scientific calculator.

A verification of the above method is provided in ***Figure 1***. During Hurricane Lili in 2002, the National Data Buoy Center (NDBC) had two buoys, #42001 located near R, and #42003 located due east along 26°N, approximately 280 km from 42001. The wind speed measurement was 10 m for both buoys. From theNational Data Buoy Center (NDBC) Web site (http://www.ndbc.noaa.gov/) we have at 20Z 2 October 2002 at #42001, $\mathbf{P_0}$ = 956.1 mb. Substituting this $\mathbf{P_0}$ into Equation (4), $\mathbf{U_{10\,max}}$ = 47.5 **m/s**, it is in excellent agreement with the measured value of 47.2 **m/s**. Therefore, Equation (4) is further verified. At the same time, $\mathbf{P_\gamma}$ = 1011.1 mb was measured at #42003. Substituting this $\mathbf{P_\gamma}$ into Equation (3) , we obtain

$$\begin{aligned} U_{10\gamma} &= 47.5\left[\ln\frac{1013 - 956.1}{1011.1 - 956.1}\right]^{0.5} \\ &= 47.5\left[\ln\frac{56.9}{55.0}\right]^{0.5} \\ &= 47.5\left[\ln 1.03\right]^{0.5} \\ &= 8.8\ m/s \end{aligned}$$

The measured $\mathbf{U_{10\gamma}}$ at 42003 was 9.2 **m/s**. Since the difference between 8.8 and 9.2 is (9.2 - 8.8)/9.2 or approximately 4%, we conclude that Equations (3) and (4) can be used for nowcasting using the shipboard pressure measurement and $\mathbf{P_0}$ which is available via official "Advisory" during a hurricane.

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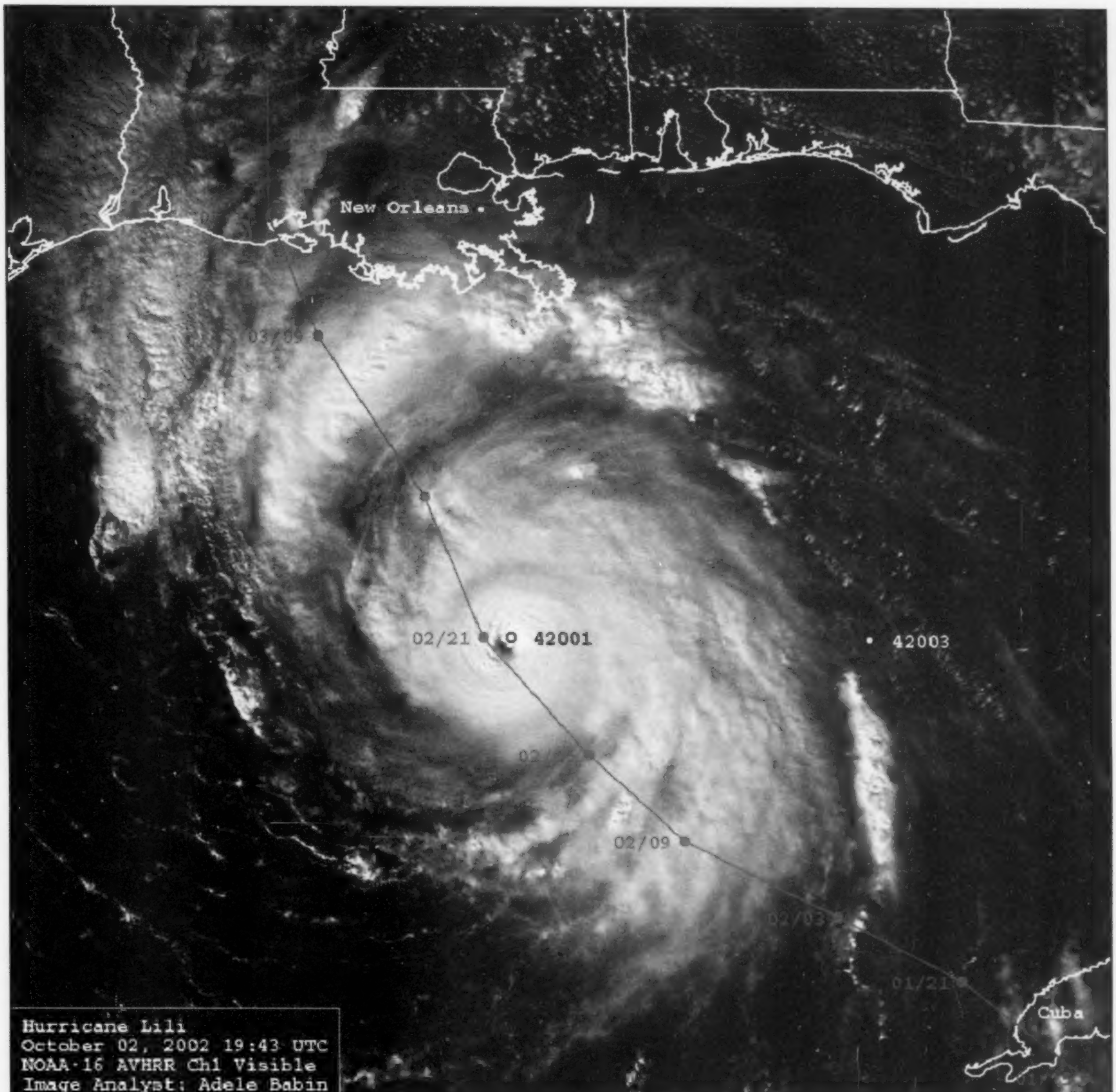


Figure 1. Satellite data (visible channel from NOAA-16) received and processed at the Earth Scan Lab, Louisiana State University, during Hurricane Lili (2002) in the Gulf of Mexico. The solid line represents the storm track. Data from NDBC buoys 42001 and 42003 are employed in this study.

Characteristics of the Gust Factor Measured by Coastal-Marine Automated Network (C-MAN) Stations During Hurricane Georges in 1998

Professor S.A. Hsu
Louisiana State University

The gust factor is the ratio of peak gust to sustained wind speed. Two questions often raised are: "Does the gust factor increase with wind speed?" and "Does it increase with height?" In order to respond, simultaneous measurements from a large number of stations are needed. Such an opportunity arose during Hurricane Georges in September 1998. The measurements are listed in ***Table 1***, along with the anemometer height for each station. It can be seen from this table that the gust factor does not increase with either height or sustained speed within approximately 20 to 160 ft and 24 to 81 kts.

Between 1400 and 1500 UTC on 25 September 1998, four stations along the Florida Keys provided an interesting sub-data set. These four C-MAN stations are: Molasses Reef (MLRF1), Long Key (LONF1), Sombrero Key (SMKF1), and Sand Key (SANF1). When the wind speed increased from 46 kts at MLRF1 to 81 kts at SMKF1, the gust factor remained virtually the same at both locations, even though the anemometer height at MLRF1 is 52 ft versus 159 ft at SMKF1. We therefore conclude from the data provided in ***Table 1*** that the gust factor does not increase with either height or speed. Certainly, more data are needed to substantiate this conclusion. ⚓

Location (Ranked by anemometer ht)	Sustained Wind (kts)	Peak Gust (kts)	Gust Factor	Anemometer Height (m)	Anemometer Height (ft)
Dry Tortugas, FL	59	68	1.15	5.7	19
Long Key, FL	47	58	1.23	7.0	23
Cape San Blas, FL	38	43	1.13	9.8	32
Keaton Beach, FL	30	37	1.23	10.0	33
Cedar Key, FL	29	34	1.17	10.0	33
Venice, LA	24	27	1.13	11.6	38
Sand Key, FL	56	71	1.27	13.1	43
Lake Worth, FL	30	35	1.17	13.7	45
Molasses Reef, FL	46	53	1.15	15.8	52
Grand Isle, LA	40	50	1.25	15.8	52
Dauphin Island, AL	59	71	1.20	17.4	57
Southwest Pass, LA	54	63	1.17	30.5	100
Fowey Rocks, FL	45	52	1.16	43.9	144
Sombrero Key, FL	81	92	1.14	48.5	159

Location (Ranked by sustained wind speed)	Sustained Wind (kts)	Peak Gust (kts)	Gust Factor	Day	Time
Venice, FL	24	27	1.13	30	1800
Cedar Key, FL	29	34	1.17	30	0500
Lake Worth, FL	30	35	1.17	25	1400
Keaton Beach, FL	30	37	1.23	29	2300
Cape San Blas, FL	38	43	1.13	29	1900

Table 1. Variations of the gust factor with height and sustained wind speed as measured by NDBC's C-MAN stations during Hurricane Georges in September 1998.

This article previously appeared in the Mariners Weather Log Fall/Winter 2002 without the accompanying table. The article is reprinted in this issue to include the table.

Application and Use of Volunteer Observing Ship (VOS) Data at the Tropical Prediction Center/National Hurricane Center

Jamie R. Rhome
Tropical Analysis and Forecast Branch
NOAA/Tropical Prediction Center/National Hurricane Center

Introduction

The Volunteer Observing Ship (VOS) Program is an integral component of the National Weather Service's Marine Program. In addition to providing observations over data-sparse regions for the purposes of initializing numerical weather prediction models and developing baseline climatology, the VOS program provides real-time observations which are used to issue watches/warnings, locate synoptic features such as fronts and lows, define the surface pressure and wind field, and characterize features such as gales and storms.

The purpose of this article is to outline a few of the many operational uses of the VOS data at the Tropical Prediction Center/National Hurricane Center (TPC/NHC). The motivation stems from a VOS program meeting held in Kansas City, MO, during December 2002 where participants commented that a clarification of these applications was desired. While this discussion is not meant to be an exhaustive list of all applications, a broad overview of the most relevant will be briefly presented in the hopes of providing increased awareness on the significant importance of this data to the operations of the National Weather Service (NWS) and more specifically the TPC/NHC.

It should be noted that the main goal of tropical cyclone and marine forecasts is to help mariners avoid hazardous and/or inclement weather. However, sometimes rapidly evolving or developing systems do not allow time for avoidance. In these situations, the data is extremely valuable and may be the only data available to make a watch/warning decision. Hourly or three-hourly observations are requested in these situations.

Overview of Operations at TPC/NHC

The TPC is one of nine national centers within the National Weather Service's National Centers for Environmental Prediction (NCEP). These centers provide a variety of national and international weather products, which generally focus on large-scale areas or regions. The Ocean Prediction Center (formerly known as the Marine Prediction Center) is also one of the nine NCEP centers.

The TPC's mission is to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, forecasts and analyses of hazardous tropical and marine weather, and by increasing understanding of these hazards. In addition to the Hurricane Program, which has responsibility for tropical cyclone analysis and forecasts products, the TPC also has responsibility for issuing marine forecasts for the subtropical ant tropical North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and the eastern subtropical and tropical North Pacific Ocean. In fact, non-tropical related events (gale and storm) constitute over half of the total warnings issued by the Tropical Analysis and Forecast Branch (***Figure 1***). These forecasts are issued year round regardless of tropical cyclone activity.

The TPC is comprised of three units including the National Hurricane Center (NHC), the Tropical Analysis

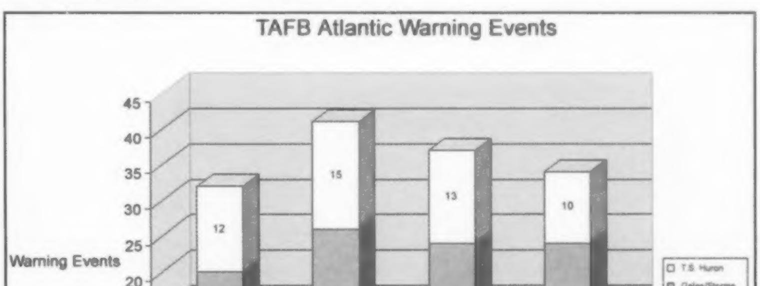


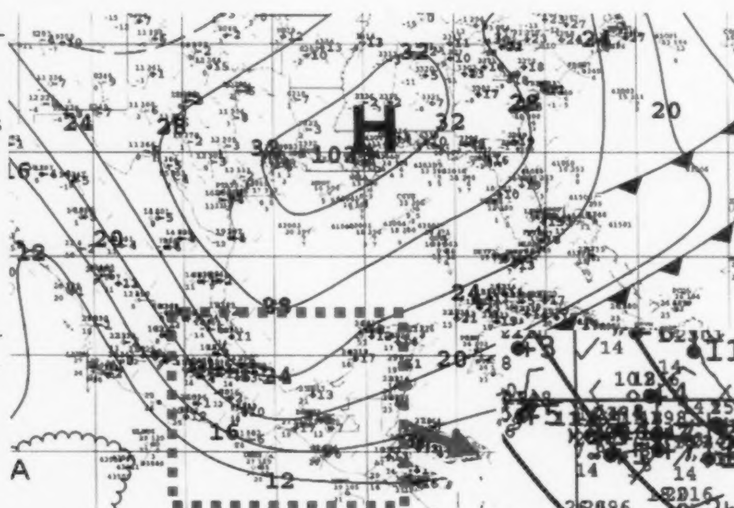
Figure 1. Composite of total TAFB warnings by year (1999-2001).

and Forecast Branch (TAFB), and the Technical Support Branch (TSB). While all three branches work very closely to ensure the overall TPC mission, each branch specializes in select areas.

The NHC maintains a continuous watch on tropical cyclones, from 15 May in the eastern Pacific and 1 June in the Atlantic, through 30 November, including the preparation and issuance of forecasts and watches/warnings within the area of responsibility. During the "off-season," the NHC conducts an extensive outreach and education program, which includes training U.S. emergency managers and representatives from many other countries affected by tropical cyclones.

The TAFB provides year-round marine weather analysis and forecast products over the tropical and subtropical waters of the eastern North and South Pacific and the North Atlantic basin. The branch is comprised of three operational desks (Atlantic Marine Forecast Desk, East Pacific Marine Forecast Desk, and Tropical Analysis and Forecast Desk), as well as a backup desk for other NCEP centers. The branch also produces satellite based weather interpretation and rainfall estimates for the international community. Additionally, the TAFB provides operational and forecast support to the NHC through manpower and satellite analysis of tropical cyclone activity.

The TSB provides technical support for computer and communications systems and maintains a small applied research and techniques development unit which develops tools for hurricane and tropical weather analysis and prediction. TSB also has a storm surge group, which provides information for developing evacuation procedures for coastal areas.



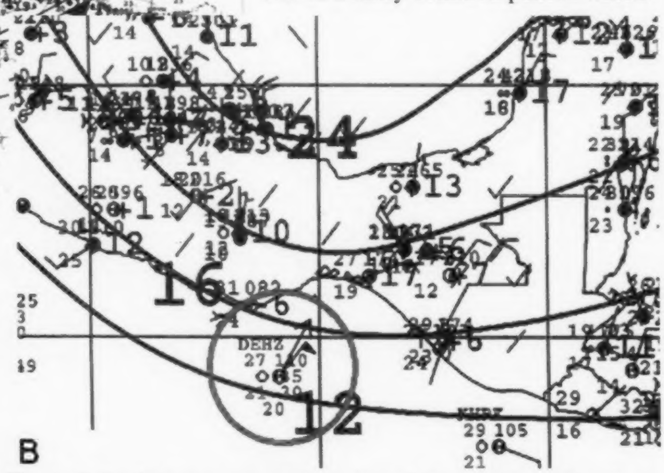


Figure 2. Surface pressure analysis (panel A) with boxed location shown in panel B.

Application of VOS Data

Issuing Watches and Warnings

One of the primary responsibilities of the TPC is the issuance of watches and warnings, which include gale warnings, storm warnings, tropical storm watches/warnings, and hurricane watches/warnings. The timely and accurate issuance of these watches/warnings is dependent upon knowing not only what will happen in the future, but also what is happening now. This task would be difficult without accurate surface reports and would rely primarily on satellite and numerical model output. While both satellite and numerical models are tremendous tools for operational forecasters, they are in no way a replacement for accurate ship observations. Additionally, cases often arise where weather conditions are stronger/weaker than what would be expected by simply evaluating the large-scale pattern or numerical output.

An example is given in ***Figure 2*** for the case of storm force winds within the Gulf of Tehuantepec. Panel A shows a fairly common pattern which occurs over TPC's area of responsibility during the winter months. A strong (1033-hPa) migratory high-pressure center is moving eastward along the southeastern United States behind a

cold front over the Western Atlantic. This pattern is typically associated with strong winds over both the Gulf of Tehuantepec and Gulf of Papagayo.

While pattern recognition would alert the forecaster to the possibility of strong winds over both locations, it provides little insight into the relative magnitude of an event. Typically, a high center location over the southwestern Gulf of Mexico or Bay of Campeche produces the strongest winds within the Gulf of Tehuantepec. However, in this case, the high center is located further north along the Gulf Coast. Nonetheless, the relatively high surface pressure (1033 hPa) would likely warrant strong winds and possibly a gale warning for the Gulf of Tehuantepec.

A closer inspection of the area of interest (Panel B) reveals the ship **Hanover Express** (DEHZ) moving through the Gulf of Tehuantepec region reporting winds of 50 knots (kts). This particular report was the only ground truth observation within the area of interest and the sole indication that storm force conditions were occurring. Without this observation, the decision to issue a gale warning, storm warning, or no warning would have been based on the surface pressure pattern (pattern recognition and experience) as well as numerical model output. Given the unfavorable location of the parent high pressure center, a storm warning would likely not have been issued. This case clearly indicates the importance of a single ship observation in the watch/warning decision making process.

Estimating Tropical Cyclone Intensity and Wind Radii

One of the most important tasks in the hurricane forecast process is estimating the initial position, intensity, and size of the system. Imagine issuing a forecast and/or warning for a system whose location, intensity, and size is unknown. Precise initial conditions are also crucial for the proper initialization of numerical weather forecast models.

An example of the role ship observations can play in this process is demonstrated in ***Figure 3*** which shows the surface pressure analysis and available surface observations for Tropical Storm Gabrielle on 13 September 2001. Note the ship immediately east of Gabrielle, which is reporting 40 kts wind and 1003.9 hPa surface pressure. This particular ship supplied crucial data, which supported the upgrade of the system from a tropical depression to a tropical storm at 11AM that morning. Additionally, the ship helped locate the center and define the surface pressure field associated with Gabrielle, which are two crucial variables used to initialize numerical guidance.

The following is an excerpt from the 11AM Tropical Cyclone Discussion (TCD): "Two surface observations...from ships with call signs DCUW (**Santa Maria**) and **WCZ5238**...of 35 and 40 kts winds respectively...support upgrading the cyclone to Tropical Storm Gabrielle." Given the location of Gabrielle over open water away from land observations, the intensity and surface pressure field would have had to have been estimated without the nearby ship observations.

Another good example of the importance of ship observations in tropical cyclone intensity estimation occurred on 19 September 2002. A nearby ship indicated that tropical storm Josephine was much stronger than satellite-based intensity estimates. The morning discussion read, "In a bit of a surprise, ship **Albatros** (C6LV3) reported 50 kts winds about 100 miles southeast of the center at 12Z, so that is the initial intensity for this advisory."

Locating and Defining Synoptic Surface Features

The TPC provides surface analyses every six hours at the synoptic times (00, 06, 12, and 18 UTC). These analyses are among the most widely used products by the marine community, as they provide tremendous

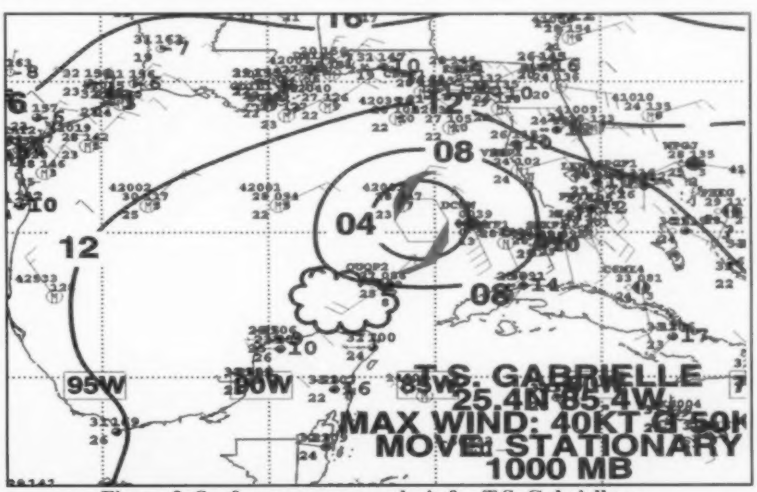


Figure 3. Surface pressure analysis for T.S. Gabrielle on September 13, 2001.

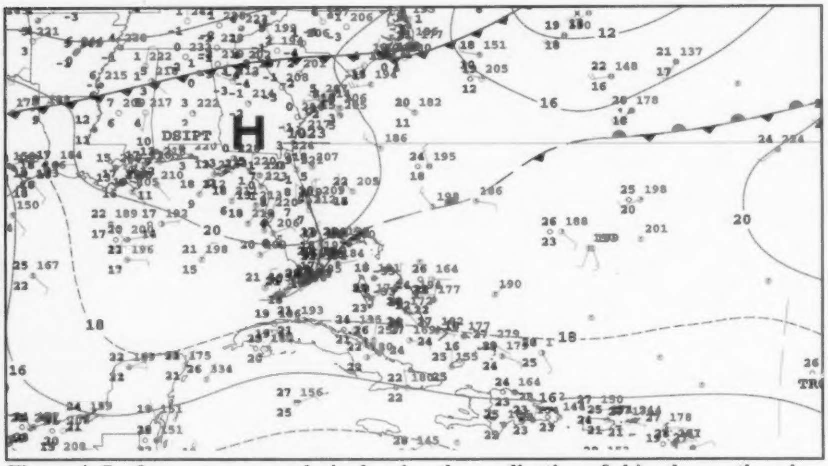


Figure 4. Surface pressure analysis showing the application of ship observations in locating frontal boundaries.

amounts of information on current and anticipated weather conditions, including active warnings. Since these analyses focus primarily over open water (another NCEP center provides analyses over the continental United States), ship observations are the main source of information used in the compilation. While the VOS data is supplemented by C-MAN stations, moored buoys, and drifting buoys, ship reports provide the majority of the data used in the assembling of these analyses.

Figure 4 shows a rather common situation where two ship observations indicate the exact location of a frontal boundary. This particular case occurred during the evening hours when visible satellite imagery was no longer available. Additionally, the front was masked by overcast middle to upper level clouds in infrared satellite imagery. Thus, the boundary was particularly difficult to locate, as are many surface features at night or when high clouds are present. However, the two highlighted ships in ***Figure 4*** clearly show the location of the frontal boundary. The front would have been much more difficult to locate without the two ships, and the realm of possible positions may have ranged by as much as several hundred nautical miles based on the next closest ships.

Surface boundaries alone may not seem like an overly significant feature; however, they can have a large impact on the surface wind field and weather. For example, in this case the wind is primarily north to northwest poleward of the boundary and south to southeast equatorward of the boundary. Not knowing the location of this boundary could constitute a possible 180-degree error within the wind field analysis and forecast.

Interpreting and Verifying Numerical Model Output

There are many operational numerical models utilized at TPC, each having its own set of strengths and weaknesses as well as biases. The challenge for the operational forecaster is knowing these biases and determining which of the many models is most accurate/applicable for any given situation or weather pattern. This task is even more complicated by the fact that a model may handle one weather feature well and another incorrectly. Additionally, model performance can vary from day to day, year to year, or event to event. Thus, the forecaster must evaluate each model's overall performance and then apply that knowledge to the forecast. This is where the application of the ship data is very important. The VOS data provide ground truth for the verification of the models, which greatly aids in determining how well the model is performing.

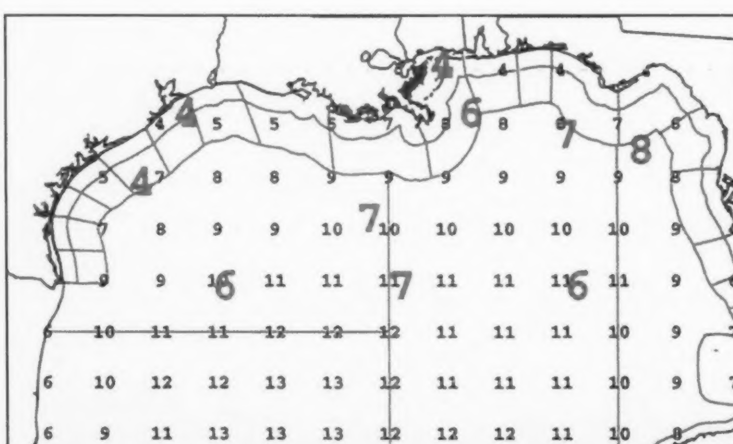


Figure 5. Significant wave heights (feet) from NOAA Wave Watch 3 (NWW3) numerical model (evenly spaced smaller numbers), along with significant wave heights (feet) from available buoys (larger numbers).

An

example is given in ***Figure 5***, which shows the significant wave height forecast from the NOAA Wave Watch 3 (NWW3) model compared with buoy observations over the Gulf of Mexico. Note that the model significantly overestimated the sea heights over the central Gulf of Mexico by as much as a factor of two. While no ship data is shown in ***Figure 5***, it does highlight that numerical models can have significant biases that can only be evaluated by observations. In areas devoid of observations, the model biases cannot be determined which may lead to significant forecast error.

Verifying Remotely Sensed (Satellite) Data

The last few years have witnessed a wealth of advanced satellite technology and instrumentation, allowing scientists to probe the atmosphere in ways previously impossible. One of the most applicable advances for the marine community is the ability to estimate both wind speed and direction via satellite imagery.

Seawinds/Quikscat is a sun-synchronous polar orbiting satellite equipped with an active microwave-sensing instrument (13.4 GHz, 110-watt) that estimates surface wind over the ocean by measuring reflection/scattering off the ocean surface waves. The potential application is far reaching in terms of providing better data coverage over open water. However, there are many limitations to this new data, and the estimations are not always accurate. For example, data is only available at any given location approximately twice per day given the satellite is polar orbiting (circles the earth) rather than geostationary (location remains fixed). Additionally, the wind estimates can often be contaminated by heavy rain. Thus, it is sometimes difficult to know whether satellite-based surface wind observations are accurate or how to apply old data (Quikscat winds are not continuous) to a current analysis/forecast. However, satellite-based data becomes much more useful when used in conjunction with ship observations.

An example is given in ***Figure 6***, which shows 10-meter wind estimates from Quikscat along with available surface ship observations. There are two areas of interest: the Gulf of Papagayo and the Gulf of Tehuatepec. In this particular case, a ship report is available in each location. A ship moving through the Gulf of Tehuantepec region is reporting 35-kts winds and 5.5-m (18-foot) seas. This alone is extremely valuable information, as it indicates gale force conditions exist and warrants the issuance of a warning (if one is not already issued). However, the question now becomes, how large of an area do gale force winds cover? The ship observation also indicates that the Quikscat surface wind estimates are accurate and allows the forecaster to determine the areal extent of the gale force winds. Additionally, the Quikscat data indicates winds to near-storm force north of the ship observation. Without the ship, the forecaster would have been left guessing how accurate the Quikscat wind estimates were in this case. With the ship observation, however, the forecaster could be reasonably confident that the Quikscat winds were accurate and make appropriate decisions regarding the issuance of a gale versus storm warning.

A similar analysis can be drawn over the Gulf of Papagayo where a ship is reporting 15 kts. Again, the Quikscat wind estimates match up well with the ship report, thus allowing increased confidence in the Quikscat observations.

Conclusions

This article has demonstrated just a few of the many operational applications of VOS observations in an attempt to highlight the importance of the program. While satellite technology and numerical weather prediction models have made tremendous advances during the last several years, ship observations remain the most

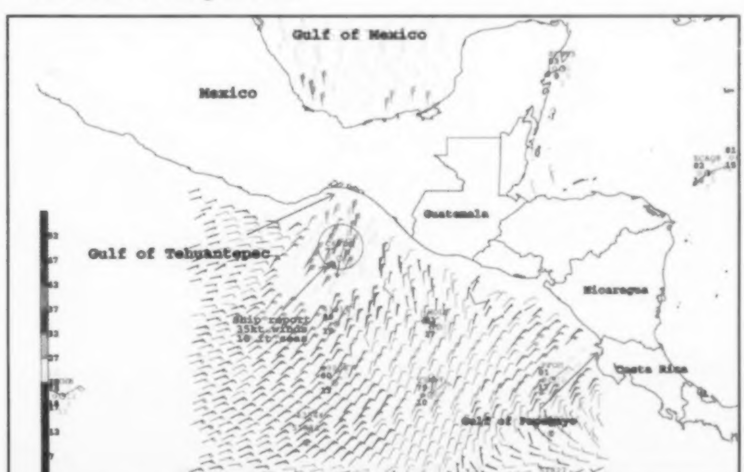


Figure 6. Quikscat satellite based 10-meter wind estimates along with available ship observations for a case of storm force winds over the Gulf of Tehuantepec.

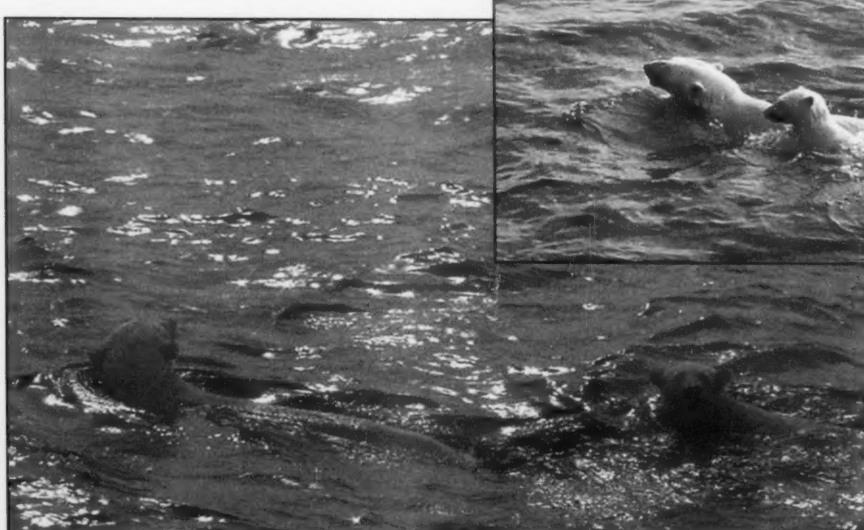
widely used and accepted ground truth observations. These observations form the very foundation of an accurate marine analysis and forecast. In fact, one could easily draw a parallel between ship observations and weather radar. Both play a pivotal role in the timely and accurate issuance of weather warnings and general surveillance. Without accurate ship observations, the marine program would surely suffer.

Biography

Jamie Rhome has worked as a meteorologist/forecaster for the Tropical Analysis and Forecast Branch of the Tropical Prediction Center since September 1999. He received his B.S. and M.S in Meteorology from North Carolina State University. Previous work experience includes the United States Environmental Protection Agency and the State Climate Office of North Carolina. ⚓

Polar Bears in Alaskan Waters

Pictures taken in August 2002 by the crew of the Crowley Tug Sinuk while visiting Barrow, Alaska.



James B. Colgate Wrecked on Black Friday

Skip Gilham
Vineland, Ontario, Canada

The name "Black Friday" was given to the date of October 20, 1916, after a violent storm sank ships and ended lives on Lake Erie. The **James B. Colgate** and her crew were among the victims, and only the captain survived.

A cargo of hard coal had come aboard at Buffalo and was consigned to Fort William, ON (now Thunder Bay). Despite a rising wind and the sound of waves crashing the outer breakwall, the vessel cast off lines and departed on its final voyage shortly after midnight October 20.

Lake Erie, the shallowest of the five Great Lakes, responded to the high winds with towering seas that pounded the **James B. Colgate** as it made its way west. That evening the ship developed a list and, within hours, slid bow first to the bottom of the lake.

Without radio communications and unable to launch the lifeboats, the crew struggled in the frigid waters to cling to anything that floated free. Three men, including the captain, found a small life raft. The cruel waves flipped their flimsy craft several times, and by morning only the captain was alive.

Fortunately, the lake settled down, and he survived the day and another night before the crew of the carferry **Marquette & Bessemer No. 2** spotted the almost lifeless body on the raft and pulled him to safety.

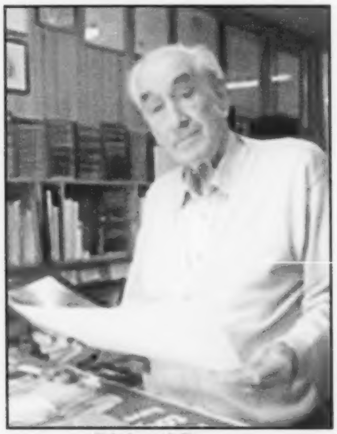
Others also perished on the lake that day. The lumber carrier **Marshall F. Butter** sank, but all were rescued. The schooner **D.L. Filer** went down and only one sailor, who clung to the mast, was rescued. Finally, the **Merida**, with 23 on board, was lost with all hands.

The **James B. Colgate** was built at West Superior,WI and launched on September 21, 1892. The 320 foot long whaleback design bulk carrier sailed for the American Steel Barge Company, Bessemer Steamship Company, Pittsburgh Steamship Company, and Standard Transit before being lost. It is shown in a photo from the collection of Captain Ken Lowes.

Divers located the hull of **James B. Colgate** in 1991. It rests upside down, some 12 miles southwest of Erieau, ON. ⚓

James B. Colgate
(Photograph courtesy of Skip Gilham)

Art by Richard Dewar



Richard Dewar

The art shown here is featured on the cover of this edition of the Mariners Weather Log. The artist is Richard Dewar from Angus, Scotland.

Richard pursued architecture as a career, but after retiring from that field his interests turned to photographing and painting clouds and skies.

His interest in clouds and skies was primarily aesthetic, aroused by their majesty, movement and the color of their ever-changing manifestations.

Richard uses pastels for his drawings.

Voyage of Mercy

Merchant mariners rescue 14,000 Korean refugees facing death

Rosanne Fohn

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In all, about 98,000 came to the docks—desperate, waiting, and hoping for their only salvation from an almost certain death—evacuation by sea. Peering through binoculars from the deck of the small merchant marine freighter, the **SS Meredith Victory**, Staff Officer Bob Lunney observed the masses of North Korean refugees lining the snow-covered piers and beach of Hungnam Harbor.

Their clothes were dirty, ragged and torn from days of plodding through the frozen countryside to Hungnam, located about 138 miles north of the 38th parallel—the official boundary between North and South Korea.

Considered to be anti-Communist sympathizers, the refugees were fleeing North Korean and Chinese troops, who were inflicting heavy casualties on the U.N. troops, including many Americans.

After a massive retreat, most of the U.N. troops had been evacuated through Hungnam when the **Meredith Victory** arrived on Dec. 22, 1950. Only the Army's 3rd Infantry Division and the ships and carriers from the 7th Fleet were holding the enemy troops at bay.

Aboard ship, Lunney, then 23, watched as a small boat pulled up and several U.S. Army colonels came aboard to speak to Capt. Leonard LaRue, the ship's master. They asked LaRue to discuss with his officers whether they should help evacuate the refugees. It was a particularly dangerous mission, considering that the ship's lower hold carried 300 tons of aviation fuel in metal drums and Hungnam Harbor was one of the most heavily mined in Korea.

"Without conferring with anyone, the captain said, 'I will agree to take my ship in and take out as many people as I can,'" recalls Lunney. With that, the **Meredith Victory's** new course

Staff Officer Bob Lunney on the deck of the *SS Meredith Victory*
(Photograph provided courtesy of Bob Lunney)


North Korean refugees stand shoulder to shoulder on the deck and fill five cargo holds.
(Photograph provided courtesy of Bob Lunney)

was set. It became one of about 150 ships to participate in the rescue of troops and civilians from Hungnam, but had the distinction of being the last refugee ship out of the harbor.

As a freighter, the **Meredith Victory** was an unarmed vessel about 450 feet long and 50 feet wide, with five cargo holds, each with three decks. Its job was to ferry supplies, such as tanks, trucks, ammunition, fuel, and troops. But today, as the ship entered the Hungnam's inner harbor, the minesweepers pulled farther and farther away. "They wanted nothing to do with our jet fuel," Lunney says.

A sea of humanity

"The port was in chaos. The beach was just a sea of humanity," Lunney recalls. "The Navy pilots were constantly attacking the Chinese with napalm bombs in support of the 3rd Infantry Division, which was holding the line. I recall this huge glow of fire on the perimeter of the city. The 1st Marine Division, the Army's 7th Infantry Division, and the Republic of Korea's I Corps had already been evacuated, and most of the artillery had been loaded onto the ships. The only heavy fire support we had at that time was from the Navy," he explains. American warships were shelling the coastline and there was some concern that "friendly fire" could cause a massive explosion.

"We had the ship turned around facing the sea—something you usually don't do—and we kept the steam on the engines, ready to leave port at a moments notice," says Merl Smith, a licensed junior engineer and Navy reservist also serving aboard the **Meredith Victory**.

The Army Corps of Engineers quickly built a wooden causeway from the beach to the **Meredith Victory** so the refugees could board. Evacuees were lowered like cargo into the holds on wooden pallets and stood shoulder to shoulder alongside the fuel drums on the ship's lowest level. As each compartment was filled, the hatch boards were put in place.

After the lower holds were full, the refugees spilled out onto the main deck. "There they were exposed to the harsh winter elements, including the frigid ocean spray," Smith recalls. Twenty-six hours later, shortly past 11 a.m. on Dec. 23, the ship was full. Amazingly, the small freighter had taken on 14,000 refugees.


The refugees braved freezing temperatures on deck during their two-day voyage.
(Photograph provided courtesy of Bob Lunney)

The *SS Meredith Victory* usually ferried such supplies as tanks, trucks, ammunition, and troops during the Korean War. In December 1950 it carried 14,000 North Korean refugees to freedom.
(Photograph provided courtesy of Bob Lunney)

Cargo of souls

In an article for "This Week" magazine, dated Dec. 11, 1960, the now-deceased Capt. LaRue said, "I cannot possibly describe the nightmarish quality of that journey. We had no food and almost no water for the refugees—they ate only what they could bring aboard. There were no extra blankets, no clothing to warm them." There were no sanitary facilities, no doctor or medical supplies and no interpreter.

"With this cargo of souls, we steamed out to the open sea toward Pusan on the southeast Korean coast. about 450 sea miles, or about 28 hours' journey," LaRue continued. "Ahead lay these formidable risks: We were facing waters mined by the enemy with a vessel that had no means of detecting them or destroying them. We knew that Communist submarines, operating in the vicinity, could easily spot us and sink us with a torpedo. A spark could turn the ship into a funeral pyre. We had no escort vessels and no way to protect ourselves against air raids. Yet nothing touched us during that incredible voyage toward Pusan.

Lunney remembers one expecially harrowing incident along the way. "The captain asked me to go down below because a number of the passengers were building fires atop the fuel drums to keep warm and to heat food" he says. After waving his arms, yelling the word "No!" and simulating an explosion with his voice and hands, the staff officer was able to get the refugees to put out their fires. Even so, there was a spark of hope—several babies were born during the voyage.

Christmas Eve

When the ship finally arrived at Pusan on Christmas Eve, it was turned away because the city was overrun with evacuees and the retreating military. The crew was astounded to learn that only a few refugees who had come aboard wounded, plus a few people identified as Communist sympathizers, would be taken off the ship. "I thought maybe some of the refugees would start jumping overboard, but they didn't," Smith recalls.

Authorities ordered the ship to sail instead to Koje-Do, an island about 50 miles to the southwest. To calm the refugees, LaRue convinced authorities to send some South Korean military police and interpreters onboard for the rest of the journey. He also requested food and water, but there was only enough for a few refugees on the deck.

The ship arrived at Koje-Do later on Christmas Eve, but it lingered overnight on the open sea while the logistical problems of unloading were resolved. The harbor was already overcrowded. They would have to use several Landing Ship Tanks (LSTs)—Navy vessels used to land tanks on a beach—to get the refugees from ship to shore.

Land at last

On Christmas Day, 1950, which also happened to be Smith's 23rd birthday, the crew finally was able to unload its human cargo. LSTs were lashed to the **Meredith Victory** and a winch and pallet lowered the refugees, 16 at a time, into them. "The risk of death or serious injury was great," LaRue was quoted as saying in "This Week" magazine. "The vessels pitched perilously in the swelling sea all through the unloading, the hulls banging and separating. The lines might part; somebody could be crushed between the two ships." Yet no one was.

As they left, the Koreans gave a half-bow. "There was no overwhelming joy on their faces because they had only begun their journey to freedom," Lunney says.

Smith says, "I can still see their faces, especially the kids. That touches me more than anything, the little kids. I can see them holding on to their parents and they haven't any idea what's going on."

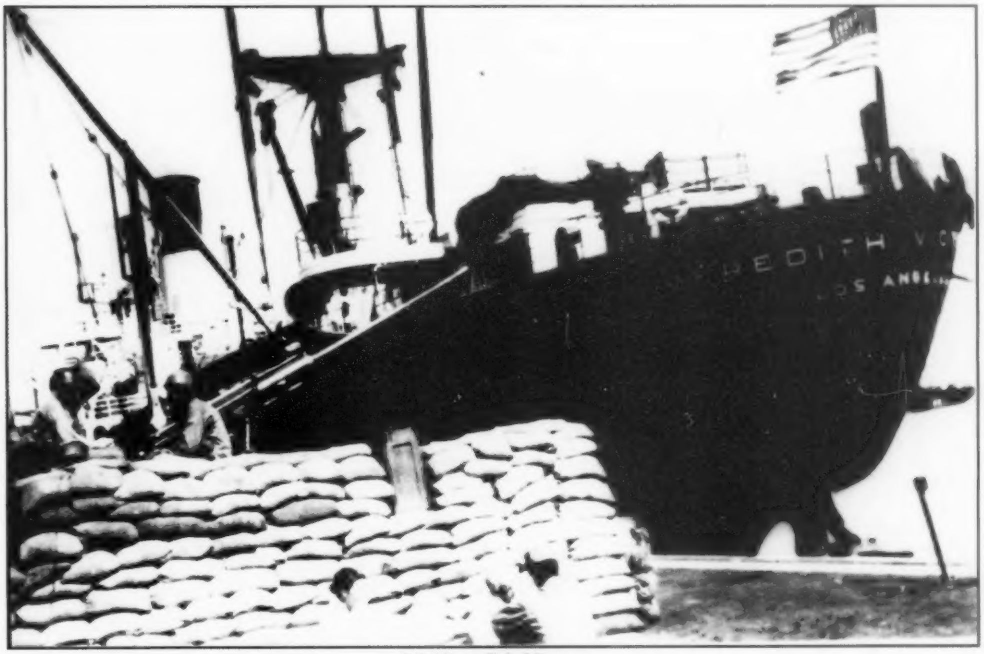
The voyage had a profound effect on LaRue. He left the sea and in 1954 became a Benedictine monk, taking the name Brother Marinus, a reference to the Virgin Mary. He lived in St. Paul's Abbey in Newton, New Jersey until his death in October 2001.

We meet again

In June of this year, Lunney had the opportunity to meet a mother and son who were passengers on the **Meredith Victory** 52 years ago. The mother, a Mrs. Kang, had carried her three children onto the ship. The youngest was 9-month old Anton Kang, who was strapped to her back. Kang is now a Benedictine priest.

Lunney says Mrs. Kang recalled the thunderous roar of the 16-inch shells from the Navy ships holding off the enemy. Kang was grateful for the opportunity to escape, he says.

While in South Korea, Lunney received the Korean Order of Military Merit Ulchi with Gold Star from the Korean War Veterans Association.



SS Meredith Victory
(Photograph provided courtesy of Bob Lunney)

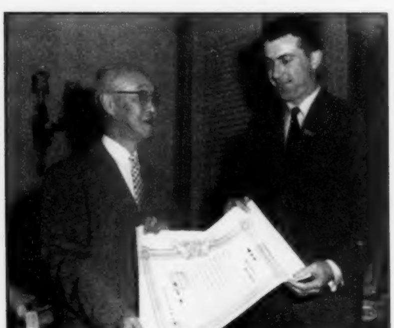
Bob Lunney

A Naval reservist who sailed with the Merchant Marine to pay his way through college and Cornell Law School, Lunney went on to practice law while continuing a nearly 43-year career in the Naval Reserve. He retired from the Navy as a captain in 1987, but continues to practice law in White Plains, New York. He was asked by the U.S. Department of Defense in 1997 and 1998 to observe joint recovery operations and confer with the North Korean Ministry of Foreign Affairs regarding prisoners of war and American servicemen missing in action.

Merl Smith

Upon graduating from the U.S. Merchant Marine Academy, Smith's first ship was the **SS Meredith Victory**. He sailed for several years on merchant ships as an engineering officer, then went on active duty with the Navy aboard the carrier **USS Boxer**. He later left the military as a lieutenant for a career as a sales marketing manager. Now, 74, Smith lives in Valatie, New York.

Merchant Marine shipmates Bob Lunney, Merl Smith, Al Kaufhold and Burley Smith on board the SS *Meredith Victory*.
(Photograph provided courtesy of Bob Lunney)



Bob Lunney accepts the Korean Presidential Unit Citation June 3, 1958, from Korean Consul General D.Y. Namkoong on behalf of the *SS Meredith Victory's* officers and crew.
(Photograph provided courtesy of Bob Lunney)

Saluting the Crew

Though its contributions were overshadowed during the Korean War, the **SS Meredith Victory** and its crew were recognized nearly a decade later:

- In 1958 South Korean President Syngman Rhee awarded the officers and crew the Korean Presidential Citation.
- In 1960 the United States government, by special act of Congress, decorated the officers and crew with the Gallant Ship Unit Citation Bar, the only merchant marine ship and crew serving during the Korean War to receive such an honor. Capt. Leonard LaRue also was presented the Merchant Marine Meritorious Service Medal.

According to retired Navy Capt. Bob Lunney's citation letter from the U.S. Department of Commerce Maritime Administration, dated April 29, 1960, "The courage, resourcefulness, sound seamanship and teamwork of her master, officers, and crew in successfully completing one of the greatest marine rescues in the history of the world have caused the name of the **Meredith Victory** to be perpetuated as that of a Gallant Ship." ⚓

Marine Weather Review – North Atlantic Area September 2002 to February 2003

George P. Bancroft, Meteorologist
Ocean Prediction Center (OPC)

Introduction

The period from September to early October was typical of late summer and early fall, with the main storm track shifted north and much of the tropical activity of the 2002 Atlantic hurricane season concentrated in this period. Some of the tropical cyclones were Gulf of Mexico systems which did not directly affect OPC's marine area but later redeveloped as intense extratropical lows in the northwest Atlantic off Labrador. By late October, the storm track shifted south as a more winter-like pattern set in over the western North Atlantic. An El Niño-driven southern branch of the jet stream contributed to frequent development of lows off the U.S. East Coast during the remainder of the period. The most active period for significant weather events was December to February, when hurricane-force lows were most frequent.

Tropical Activity

Tropical Storm Edouard: Edouard affected the far southwestern OPC waters early in September and originally developed from a non-tropical low early on 2 September off northern Florida. Edouard drifted north and stalled about 150 nmi south of Cape Romain during a 24-hour period ending at 1800 UTC 3 September, before drifting southwest into northern Florida late on 5 September. The intensity briefly peaked at 55 kt for maximum sustained winds, with gusts to 65 kt as of the 1500 UTC 3 September advisory time when the center was stalled near OPC's forecast waters.

Hurricane Gustav: Gustav, the first hurricane of the 2002 Atlantic hurri-

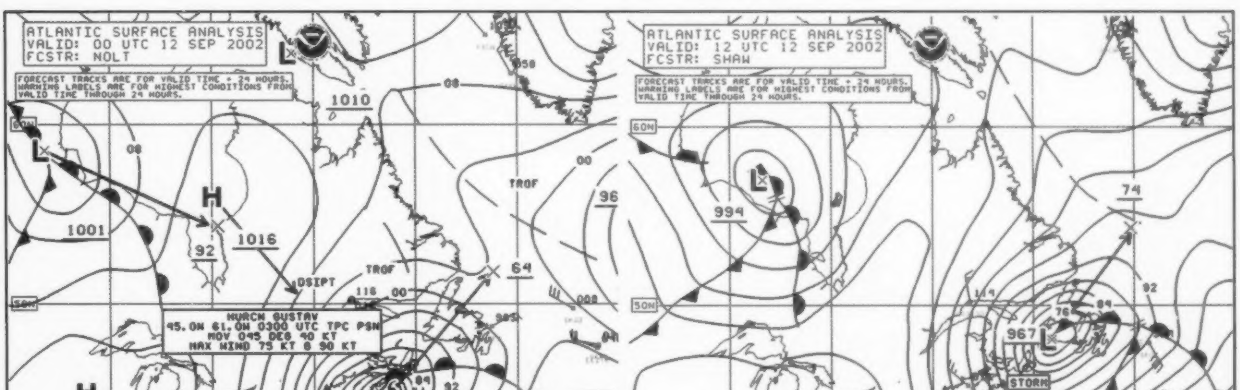


Figure 1. OPC North Atlantic Surface Analysis charts (Part 2) valid 0000 UTC and (Part 1) 1200 UTC 12 September 2002. Information on Hurricane Gustav given in the box is based on the advisory time (0300 UTC), not the chart's analysis time (0000 UTC).

cane season, formed just south of OPC's waters early on 8 September as a subtropical depression, then moved northwest and strengthened into a subtropical storm upon crossing into OPC's waters near 72W. The system turned north and became a tropical storm right before passing just east of Cape Hatteras around mid-day 10 September, with maximum sustained winds of 50 kt with gusts to 60 kt. Gustav then turned northeast and intensified to a hurricane about 200 nmi south of Nantucket at 1500 UTC 11 September, with maximum sustained winds of 65 kt with gusts to 80 kt. Diamond Shoals reported a northwest wind of 48 kt with gusts to 56 kt at 0100 UTC 11 September after the center passed. NOAA Buoy 44004 (38.5N 70.5W) reported a pressure of 977.5 hPa at 1300 UTC 11 September as Gustav passed nearby. The buoy reported winds which increased to northwest 37 kt with gusts to 60 kt one hour later, and a peak gust of 62 kt at 1500 UTC 11 September. Seas were as high as 6.5 m (21 ft) one hour later at this buoy. At Buoy 44011 (41.1N 66.6W) the pressure bottomed out at 972.4 hPa at 1900 UTC 11 September, and winds reached 45 kt with gusts to 60 kt from the northwest, one hour later. The ship **Tellus** (WRYG) encountered southwest winds of 59 kt near 38N 68W at 1800 UTC 11 September. Gustav attained a maximum intensity of 80 kt with gusts to 95 kt at 2100 UTC 11 September before becoming extratropical over the island of Newfoundland at 1200 UTC 12 September (***Figure 1***). ***Figure 2*** is an infrared satellite image of Gustav when it is about to become extratropical. Note that the system still has a circular central dense overcast typical of hurricanes but is also developing frontal struc-

Figure 2. GOES8 infrared satellite image valid 0345 UTC 12 September 2002 showing Hurricane Gustav becoming extratropical. The satellite senses temperature on a scale from warm (black) to cold (white) in this type of image. The valid time is approximately four hours later than that of the first surface analysis in Figure 1.

ture. Extratropical Gustav subsequently moved north into the Davis Strait and weakened early on 15 September.

Tropical Storm Josephine: Tropical Depression 11 formed about 600 nmi east of Bermuda on the afternoon of 17 September and moved north-northeast, becoming Tropical Storm Josephine near 35N 52W twelve hours later. The cyclone developed maximum sustained winds of 50 kt with gusts to 60 kt about 500 nmi southeast of Cape Race early on the 19th before merging with a frontal system and becoming an extratropical gale, which moved to near Greenland on the 20th before weakening.

Hurricane Kyle: Kyle formed as a subtropical depression south of OPC's waters on 20 September and then drifted north-northeast to 31N 52W as a subtropical storm early on the 21st with maximum sustained winds of 40 kt with gusts to 50 kt. The cyclone then drifted northeast to near 33N 49.5W and became Tropical Storm Kyle at 2100 UTC 22 September, before looping back to the southwest and following a meandering course westward, occasionally dipping south of 31N. Kyle became a hurricane south of OPC's waters from 25-28 September but varied between weak tropical storm and depression strength; however, north of 31N Kyle made a final turn north into OPC's waters as a tropical storm near the Georgia coast early on 11 October, moved inland over North Carolina later that day, and then moved out into the Atlantic as an extratropical gale on 12 October. The ship **C6QK** (40N 69W) reported east winds of 40 kt northeast of Kyle at 1200 UTC 12 October. The remains of Kyle later merged with a developing strong cut-off low over the eastern Atlantic on 17 October. It is interesting to note that Kyle ranked third in longevity (22 days) among Atlantic tropical cyclones of record (See Reference 1).

Other Significant Events of the Period

Northwest Atlantic Storm, late September: Tropical Storm Isidore moved ashore in Louisiana on 26 September, weakened over land, and then re-intensified after merging with a frontal zone. ***Figure 3*** depicts the remains of Isidore rapidly intensifying after emerging from the Canadian Maritimes, becoming a hurricane-force low 24 hours later, unseasonably intense for September. The system moved into an area lacking in ship and buoy data, but the scatterometer

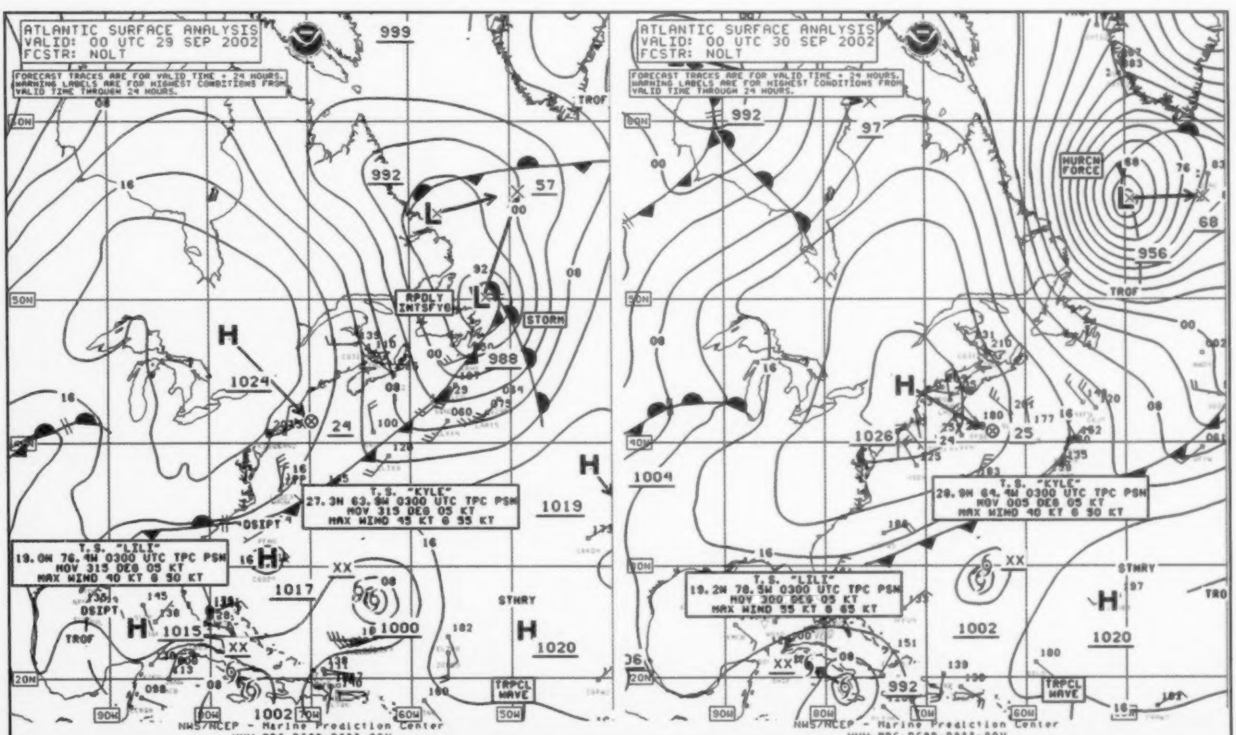


Figure 3. OPC North Atlantic Surface Analysis charts (Part 2) valid 0000 UTC 29 and 30 September 2002.

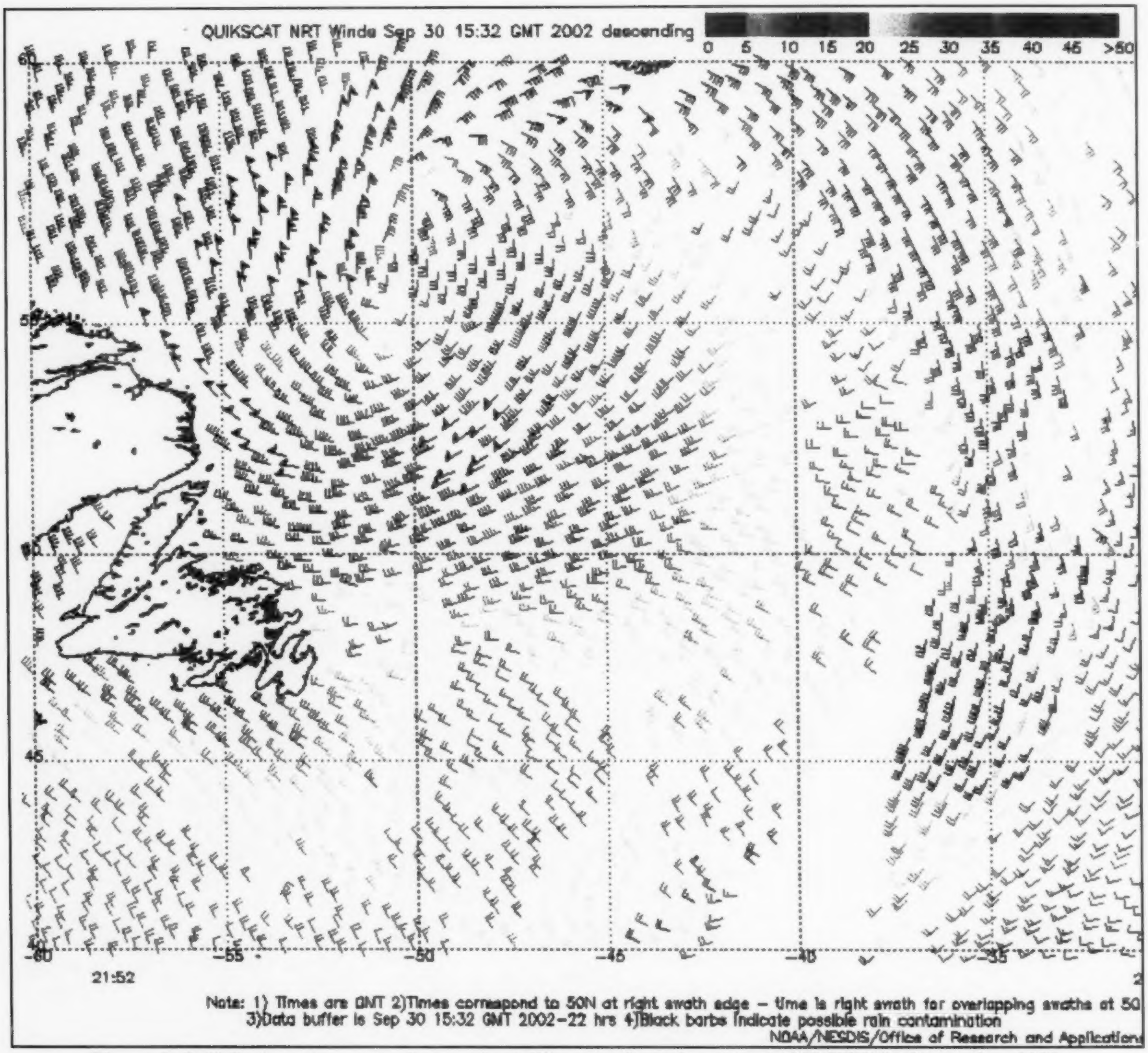


Figure 4. QuikScat scatterometer image of satellite-sensed winds valid at 1252 UTC 29 September 2002.

(Image is courtesy of NOAA/NESDIS/Office of Research and Applications)

data in ***Figure 4*** revealed winds to 65 kt on the back side. The valid time of the pass is less than three hours prior to the chart time of the second part of ***Figure 3***. The low subsequently turned east and weakened to a gale about two days later.

Strong Cutoff Low, Central and Eastern Atlantic 17-20 October: Blocking high pressure at high latitudes encouraged the development of a cutoff low in the central and eastern waters on 17 October, formed from the merger of a northern low and the remains of Kyle mentioned earlier. The combined system deepened to 962 hPa near 45N 23W early on the 20th before drifting east-northeast and beginning to weaken. OPC analyzed it as having hurricane-force strength briefly on the 19th, and the **Discovery** (GLNE) reported a southeast wind of 50 kt near 49N 12W at 1800 UTC 19 October. The system then moved northeast and into Norway on 23 October.

North Sea Storm 27 October: This low, one of a series to pass across the British Isles in middle to late October, resulted in numerous reports of storm force winds south of the rapidly-moving center in the North Sea on 27 October. The low was centered near 56N 6W at 975 hPa at 1200 UTC 27

October, when the ship **PDTM** reported a southwest wind of 75 kt near 53N 3E, while **Polarstern** (DBLK) observed southwest winds of 55 kt at 52N 3E. By 28 October the system moved into Denmark.

North Atlantic Storm 5-9 November: Low pressure developed rapidly south of the Canadian Maritimes on the 5th and passed about 350 nmi southeast of Cape Race on 6 November with a 983-hPa central pressure, while another low moved off the New Jersey coast and intensified rapidly (see ***Figure 5***). The second low developed a central pressure of 963 hPa when passing 150 nmi south of Cape Race at 1800 UTC 7 November. The second low absorbed the first late on the 8th to become a hurricane-force low about 360 nmi south of Cape Farewell, before stalling and slowly weakening. A QuikScat image taken at about that time showed a small area of hurricane-force winds, up to 75 kt, between the center and Cape Farewell. Among conventional data, the highest wind reported by a buoy was southeast 59 kt at 44602 (42.7N 47.8W) at 1500 UTC 7 November. Hibernia Platform (46.7N 48.7W) observed a northeast wind of 65 kt at 0900 UTC on 6 November, and buoy 44141 (42.1N 56.2W) observed seas up to 10.0 m (33 ft) at 1700 UTC 7 November.

North Atlantic Storm 4-6 December: This development is illustrated in ***Figure 6*** in which a complex area of low pressure moved off the Newfoundland coast at 0600 UTC on the 4th and became a hurricane-force low near 55N 40W 24 hours later. The ship **PDHW** (52N 34W) observed southwest winds of 70 kt at that time (plotted). The central pressure bottomed out at 944 hPa (27.88 inches) near 62N 36W 12 hours later, making this system the deepest of the 6-month period in the Atlantic. The cyclone then weakened while continuing to move north.

North Atlantic Storm 25-31 December: ***Figure 7*** depicts the rapid early development of this low, with OPC analyzing it as a hurricane-force low only 24 hours after moving off the mid-Atlantic coast of the U.S. The **Tanabata** (WCZ5535) (35N 64W) observed southwest winds of 60 kt at 0600 UTC on 26 December. The buoy 44018 (41.3N 69.3W) reported northwest winds of 41 kt with gusts to 54 kt at 1100 UTC 26 December, and seas as high as 8 m (26 ft). Buoy 44029 (42.5N 70.6W) observed seas as high as 9.5 m (31 ft) in this event. The cyclone then moved northeast past Newfoundland and reached 50N 49W with 952-hPa central pressure 24

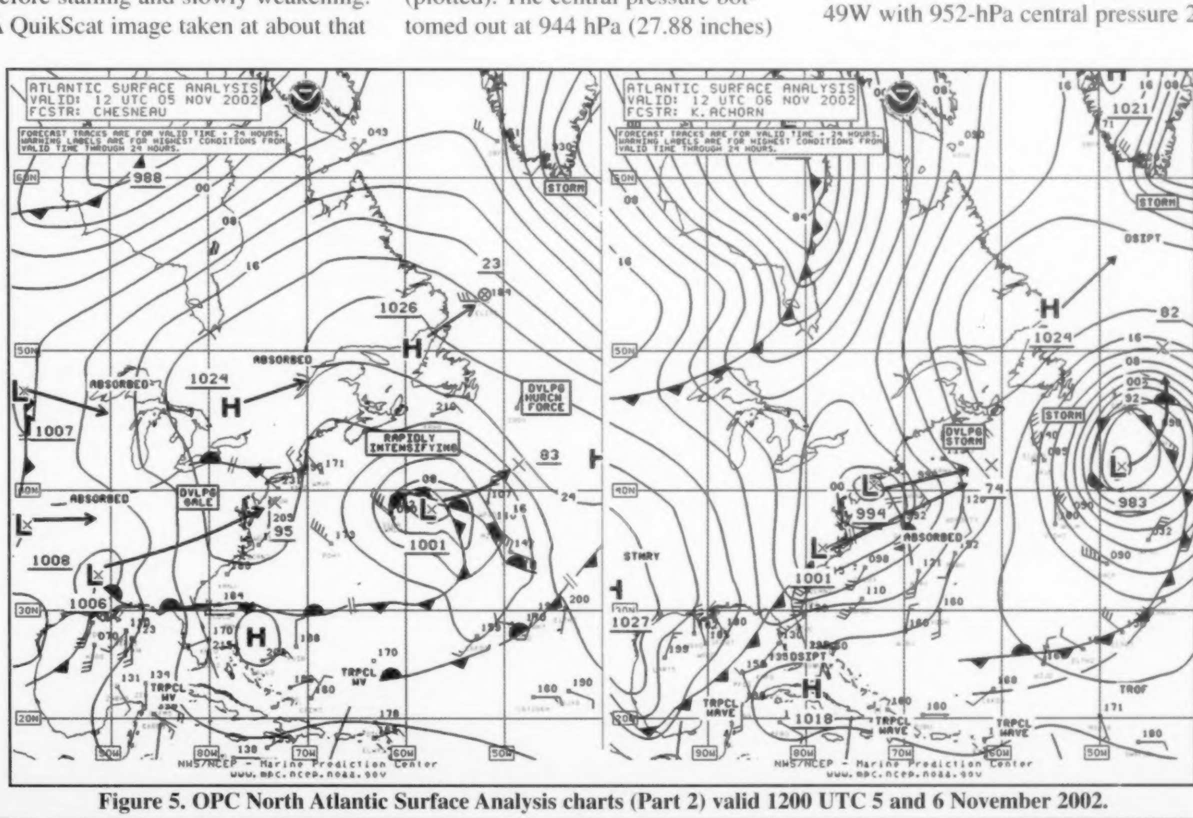


Figure 5. OPC North Atlantic Surface Analysis charts (Part 2) valid 1200 UTC 5 and 6 November 2002.

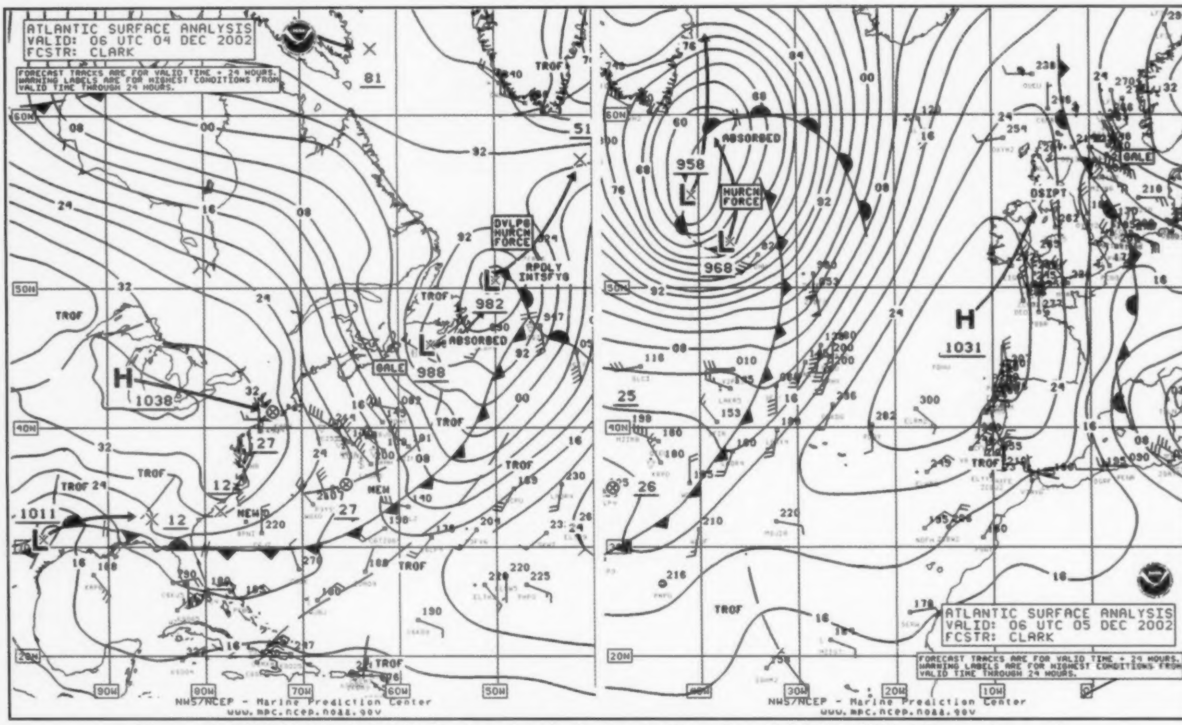


Figure 6. OPC North Atlantic Surface Analysis charts (Part 2) valid 0600 UTC 4 December and (Part 1) 0600 UTC 5 December 2002.

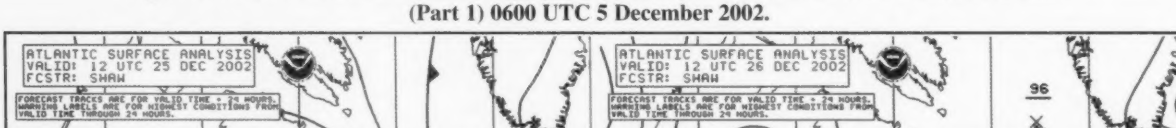


Figure 7. OPC North Atlantic Surface Analysis charts (Part 2) valid 1200 UTC 25 and 26 December 2002.

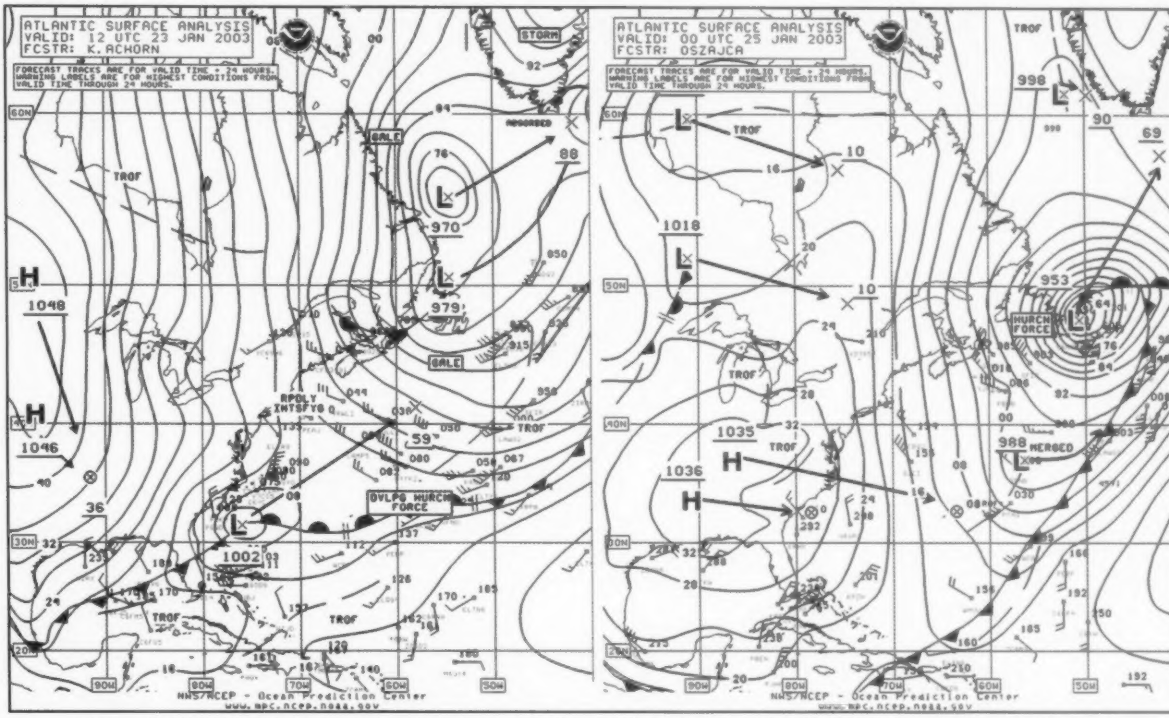


Figure 8. OPC North Atlantic Surface Analyses charts (Part 2) valid 1200 UTC 23 January and 0000 UTC 25 January 2003.

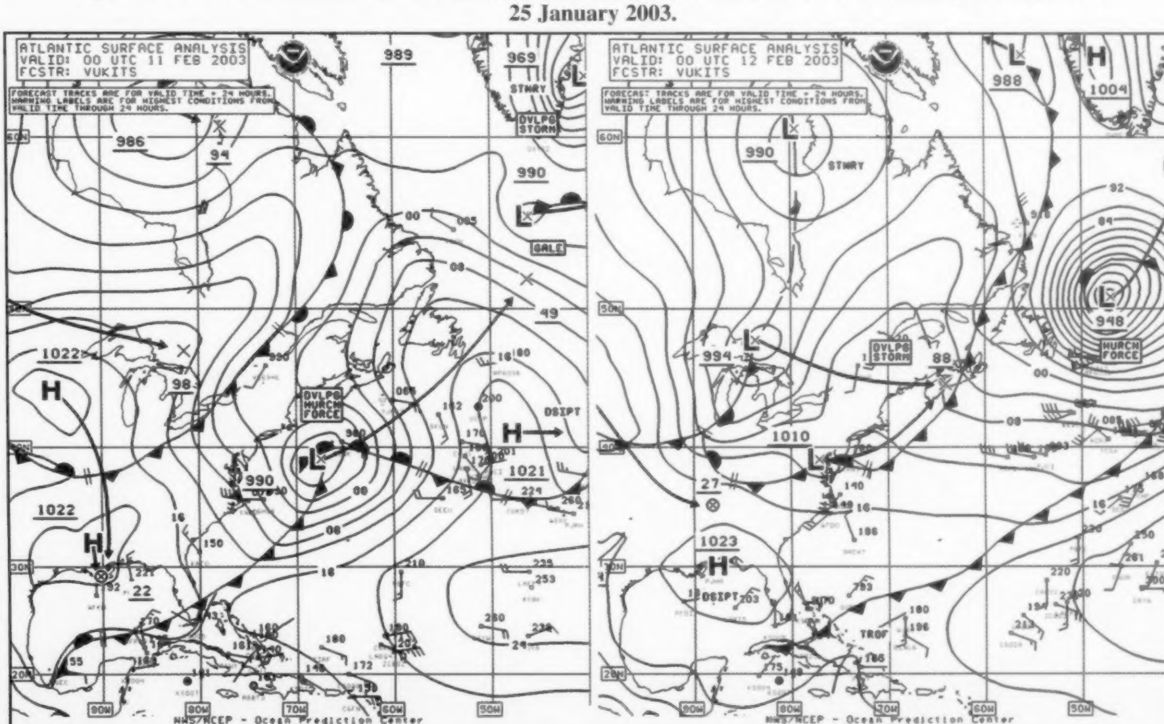


Figure 9. OPC North Atlantic Surface Analysis charts (Part 2) valid 0000 UTC 11 and 12 February 2003.

hours later before beginning to weaken and drift east. The low then became absorbed by another storm developing off the coast by month's end.

North Atlantic Storm 23-27 January: ***Figure 8*** shows the rapid development of this storm over a 36-hour period, the strongest in a series of lows to develop off the coast during this active month. A massive arctic high pressure area inland fed cold air into the system. It should be noted that the Canadian buoy 44140 broke loose in this storm; QuikScat data showed a maximum of 80 kt; and 44140 observed a peak wave of 81 ft (24.5 m and had a significant wave height increase from 13 ft (4.0 m) to 35 ft (10.7 m) in 2 hours (Reference 2). There is a wind report of southwest 85 kt at Hibernia Platform just southeast of the center in the second part of ***Figure 8***. The system subsequently continued moving northeast and gradually weakened.

North Atlantic Storms of 7-12 February: Two fast-moving rapidly-deepening lows moved off the mid-Atlantic coast of the U.S. and passed just east of Newfoundland. The second low was slightly deeper and is shown in ***Figure 9***, attaining a lowest pressure of 948 hPa east of Newfoundland late on 11 February. The highest wind reported by a ship was a west wind of 75 kt from the **Shenzhen Bay** (MSDM7) (43N 55.6W) at 1500 UTC 8 February. The same ship observed seas as high as 19.8 m (65 ft) three hours later. At 0600 UTC 9 February, the vessel **PDHW** encountered west winds of 70 kt and 14.3-m seas (47 ft). Canadian Buoy 44141 (42.1N 56.2W) reported a west wind at an impressive 62 kt with gusts to 76 kt at 1300 UTC 8 February, and seas as high as 11 m (36 ft). Hibernia Platform 6038 (46.4N 48.4W) observed winds as high as 68 kt in the first storm and 96 kt in the second storm. Early on the 11th, the **SeaLand Quality** (KRNJ) (38N 60W) and the **Atlantic Compass** (SKUN) (43N 58W) reported west winds of 65 kt. Also on the 11th, winds reached 47 kt with gusts to 60 kt from the southwest, and seas were up to 13.5 m (44 ft) at Buoy 44139 (44.3N 57.4W). ***Figure 10*** is a satellite image of the second system at maximum intensity, with a well-defined circulation of higher clouds wrapping around the center near 50N 48W. The QuikScat image of ***Figure 11*** reveals numerous 70-kt barbs south of the center. The second low subse-

Figure 10. GOES8 infrared satellite image valid 2215 UTC 11 February 2003, showing the hurricane-force storm of Figure 9 near maximum intensity. The valid time is less than two hours prior to that of the second surface analysis in Figure 9.

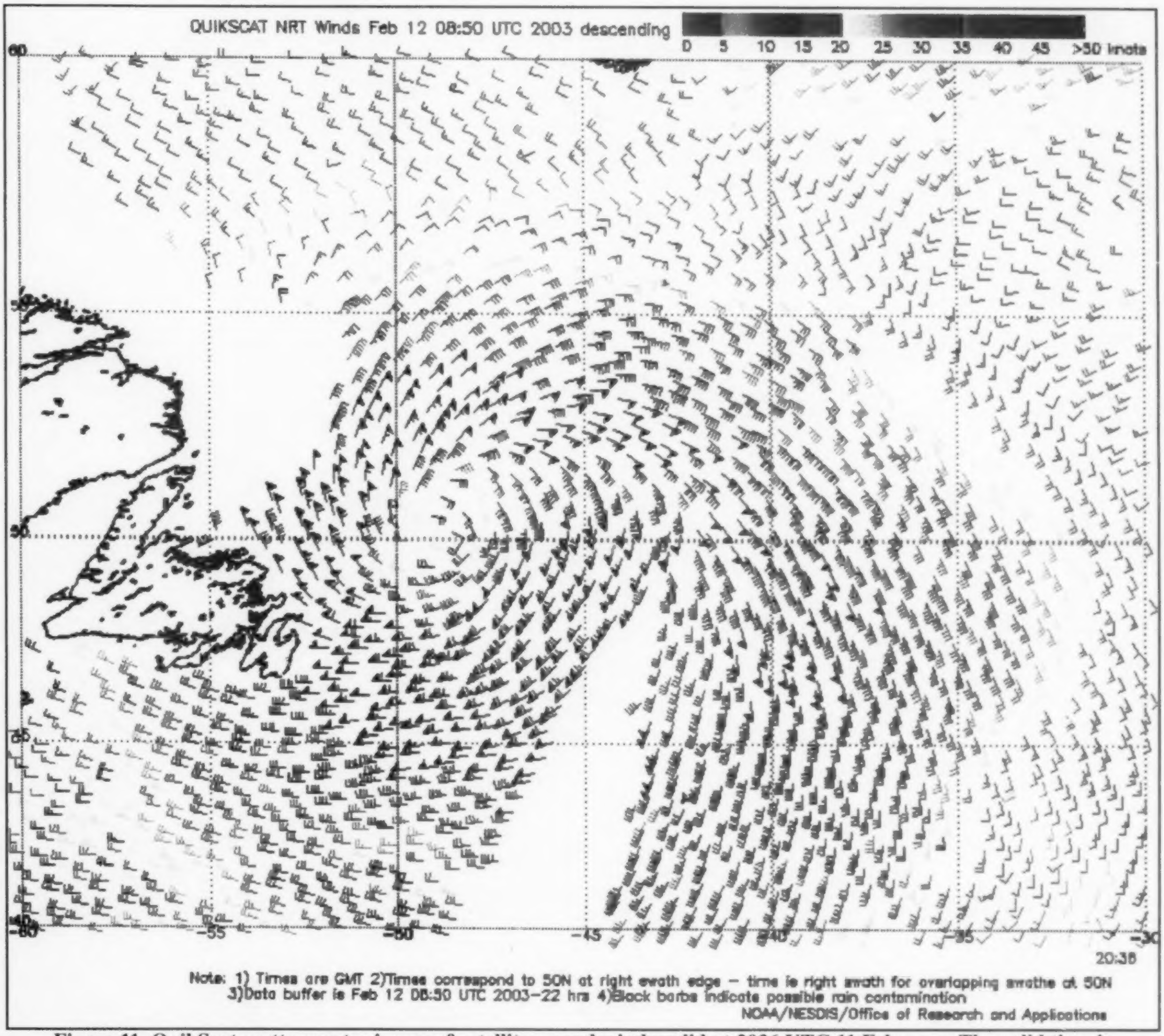


Figure 11. QuikScat scatterometer image of satellite-sensed winds valid at 2036 UTC 11 February. The valid time is approximately three and one-half hours prior to that of the second surface analysis in Figure 9.

(Image is courtesy of NOAA/NESDIS/Office of Research and Applications)

quently lifted north and weakened over Greenland on the 14 February.

North Atlantic Storm 24-28 February: Although not among the deepest lows, this event was noteworthy as being prolonged, due to the slowing of the low-pressure system after it passed off the Newfoundland coast (see ***Figure 12***). Platform VEP717 (46.7N 48.7W) reported west winds as high as 79 kt at 0900 UTC 25 February. **C6QE7** (48N 46W) observed west winds of 65 kt as late as 1200 UTC on the 27th. The **Atlantic Cartier** (C6MS4) encountered west winds of 65 kt near 50N 38W at 1800 UTC on 28 February.

References

1. Pasch, Richard J. and Lawrence, Miles B., *Atlantic Hurricanes* (Weatherwise, March/April 2003).

2. Sienkiewicz, J., E-mail communication (January 28 and February 10, 2003).

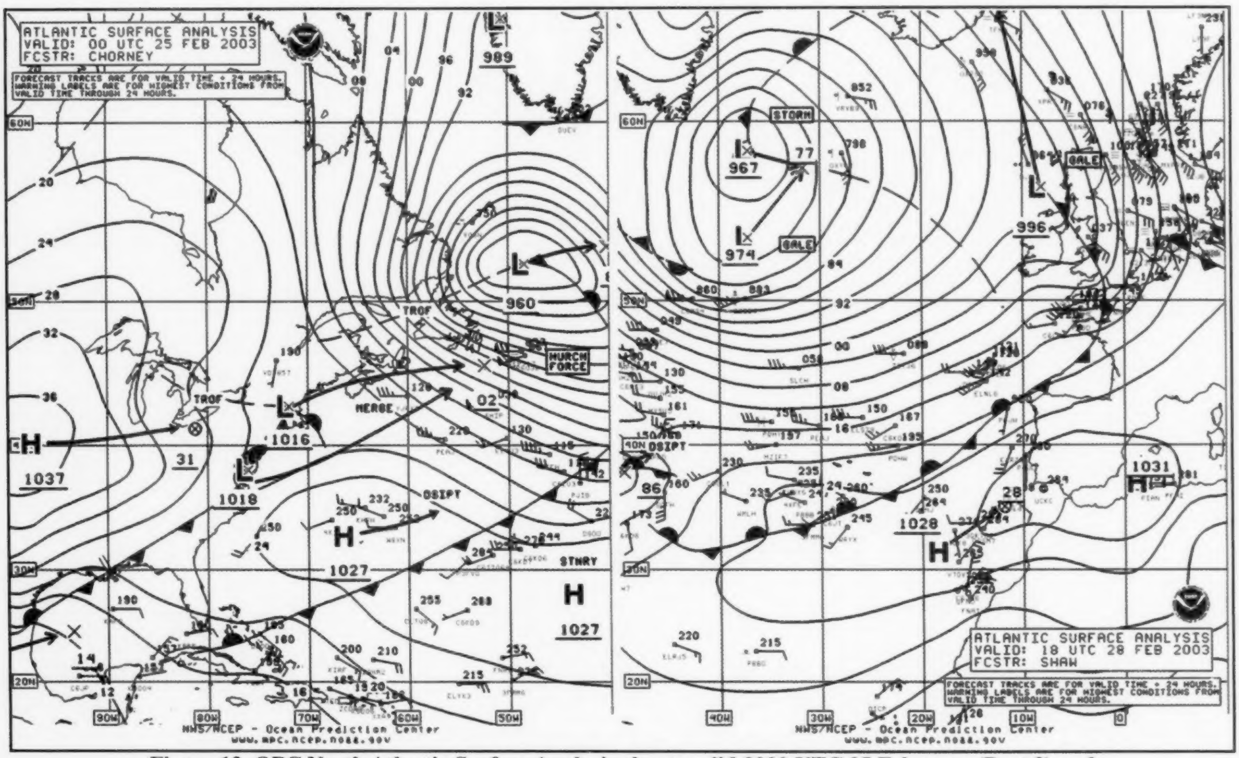


Figure 12. OPC North Atlantic Surface Analysis charts valid 0000 UTC 25 February (Part 2) and 1800 UTC 28 February (Part 1) 2003.

Marine Weather Review – North Pacific Area September 2002 to February 2003

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Ocean Prediction Center (OPC)

Introduction

The weather of the period started out more typical of late summer, with high pressure over the mid-latitudes. Three tropical cyclones were present on OPC oceanic analyses, with two of then actually in OPC's high seas area (north of 30N and east of 160E). Non-tropical weather systems became more active as the season progressed into autumn. Unlike in the Atlantic, occasional tropical activity continued into January, with some of these becoming significant extratropical lows in OPC's high seas area. The first hurricane-force low of this fall and winter period occurred in late September. Such lows became much more frequent by December, which was the most active month. There was increased high-latitude blocking in January and February, when the stronger cyclones were associated with the southern branch of the jet stream. The blocking high pressure often caused lows to slow or move erratically after turning north.

Tropical Activity

Typhoon Ele: Ele was formerly a central-Pacific hurricane which crossed 180W in August. At the start of September, Ele was near 18N 177E with maximum sustained winds of 115 kt and gusts to 140 kt, moving slowly north, then northwest. A slow weakening trend began on the 3rd. Ele was downgraded to a tropical storm near 34N 170E late on 6 September, and to a depression on the 9th, near 40N 167E. The cyclone later redeveloped as an extratropical gale-force low on the 10th near 47N 174E, and moved into Alaska on 12 September.

Typhoon Sinlaku: Sinlaku was about 600 nmi southeast of Tokyo at the start of September, with maximum sustained winds of 115 kt with gusts to 140 kt. The cyclone drifted west with a slow weakening trend, passing west of OPC's oceanic analysis area after 0000 UTC 3 September.

Tropical Depression Fausto: Formerly an eastern-Pacific hurricane (in August), Fausto tracked northwest and, by 1200 UTC 3 September, became absorbed by an extratropical gale-force low in the Bering Sea.

Super Typhoon Higos: Higos began as a tropical depression near 16N 155E early on 26 September. Moving northwest, the cyclone quickly intensified to a typhoon on the 27th, and then was a super typhoon on 29 September. It reached maximum intensity at 1200 UTC 29 September with sustained winds of 135 kt and gusts to 165 kt, near 21N 137E. Higos then turned north along 136E and began to weaken. The ship **9MBR** (33N 141E) observed southeast winds of 60 kt as Higos passed to the west, near 33N 138E, at 0600 UTC 1 October. ***Figure 1*** depicts Higos near Tokyo six hours later with maximum sustained winds of 80 kt with gusts to 100 kt, and also becoming an extratropical storm 24 hours later with fronts. The system then turned east and weakened before dissipating in the southeast Bering Sea on 6 October.

Typhoon Bavi: Bavi entered OPC's oceanic analysis area near 150E early on 10 October with sustained winds of 40 kt and gusts to 50 kt, moving north. Bavi intensified to a minimal typhoon late on the 11th near 25N 147E, and weakened to a tropical storm 24 hours later. ***Figure 2*** shows Tropical Storm Bavi with a large circulation east of Japan, approaching a frontal zone. Bavi became extratropical 12 hours later and re-intensified into a significant extratropical low with hurricane-force winds in the following 12 hours leading to the intense system in the second part of ***Figure 2***. The **Tycom Responder** (V7CY9) at 43N 166E reported west winds of 65 kt at 0000 UTC and 0600 UTC 15 October. The system then tracked east and weakened slowly, before entering the western Gulf of Alaska as a gale on 19 October.

Tropical Depression 27W: This cyclone formed near 17N 156E at 0600 UTC 17 October and moved west, strengthening slightly in 24 hours before weakening to a remnant low near 16N 148E early on 19 October.

Tropical Depression 28W: This cyclone entered OPC's oceanic analysis area near 176E at 1800 UTC 18 October but weakened to a remnant low near 20N 176E eighteen hours later.

Tropical Storm Maysak: Tropical Depression 29W formed near 20N 162E at 1800 UTC 26 October and moved southwest at first, then turned northwest six hours later. The cyclone

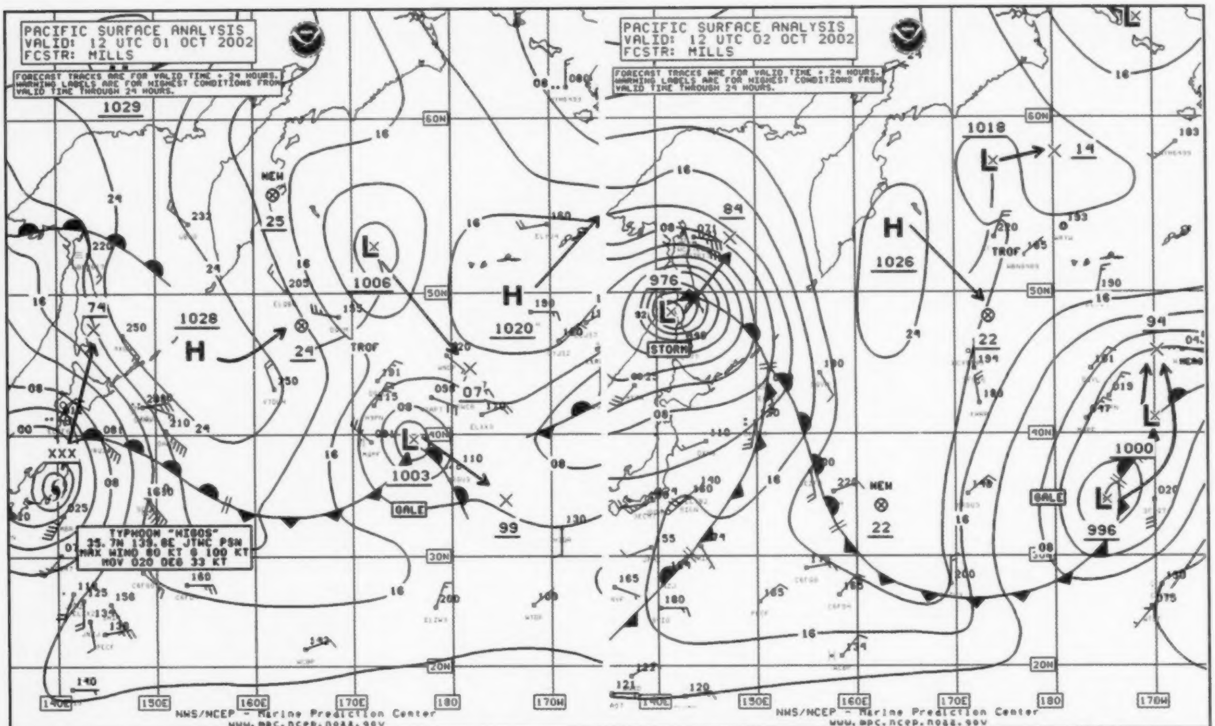

Figure 1. OPC North Pacific Surface Analysis charts (Part 2) valid 1200 UTC 1 and 2 October 2002.

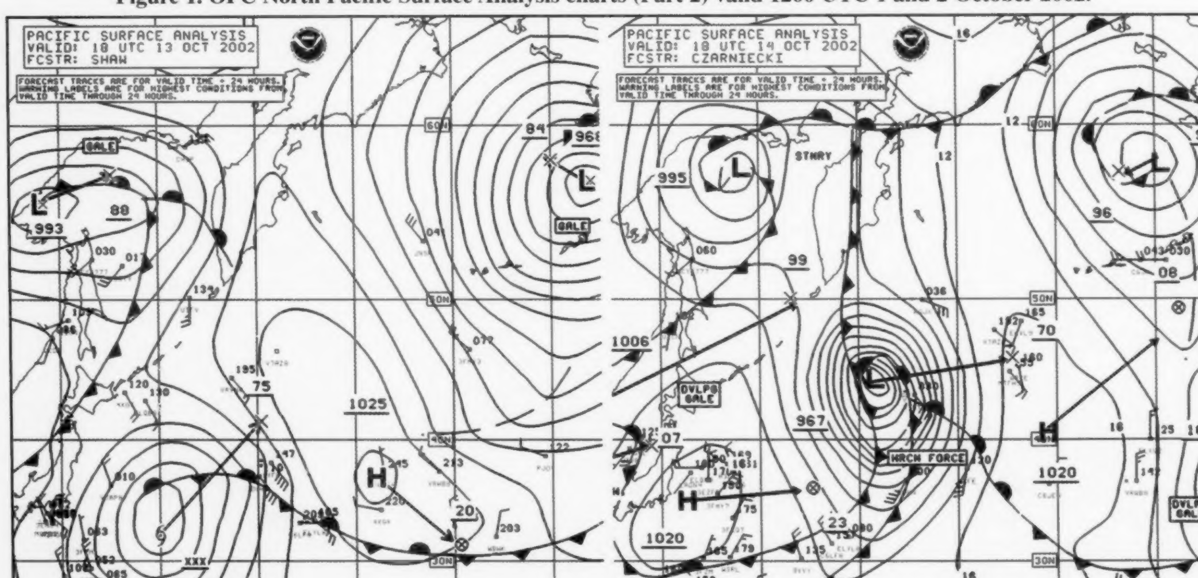

Figure 2. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC 13 and 14 October 2002.

became a minimal tropical storm near 22N 159E at 1200 UTC 27 October, continuing to intensify while turning toward the north, then northeast after 0600 UTC 28 October. Tropical Storm Maysak attained maximum strength at 1800 UTC 28 October near 28N 161E with maximum sustained winds of 55 kt and gusts to 70 kt. Maysak was approaching a frontal zone to the north and weakened to an extratropical gale-force low near 34N 174E 24 hours later.

Typhoon Huko: Huko, formerly a hurricane in the Central Pacific, entered OPC's surface chart area near 17N 175E on 3 November with maximum sustained winds of 70 kt with gusts to 85 kt. Tracking northwest, Huko weakened to a tropical storm near 26N 164E at 0600 UTC 6 November, before turning northeast and weakening to a minimal tropical storm 24 hours later. The cyclone became extratropical upon crossing the dateline early on the 7th and then dissipated.

Typhoon Haishen: Haishen moved northeast into the waters well south of Japan early on 23 November with maximum sustained winds of 85 kt and gusts to 105 kt. The cyclone weakened to a minimal typhoon near 29N 143E at 1800 UTC 24 November before becoming extratropical 6 hours later. The system re-intensified to a small, compact hurricane-force low 24 hours later near 34N 157E, when the ship **DEFA** encountered southwest winds of 65 kt near 31N 157E. Ex-Haishen then continued east and weakened over the next day, before re-intensifying and turning northeast. ***Figure 3*** captures this second re-intensification in which the central pressure dropped an impressive 42 hPa in 24 hours, bottoming out at 953 hPa. The highest wind reported from available ship data was a west wind of 55 kt from the **Maren Maersk** (OWZU2) (40N 155W) at 1800 UTC 28 November.

Typhoon Pongsona: Formerly a super typhoon south of OPC's map area, Pongsona appeared on OPC analyses near 16N 144E at 0000 UTC 9 December with maximum sustained winds of 125 kt with gusts to 150 kt. The cyclone turned to the north and then northeast and weakened rapidly after 0000 UTC on the 10th, becoming extratropical near 28N 160E at 0000 UTC 11 December and then dissipating by the 12th.

Tropical Storm Yanyan: This cyclone, near 16N 151E with sustained winds of 40 kt with gusts to 50 kt on 19 January, moved northeast

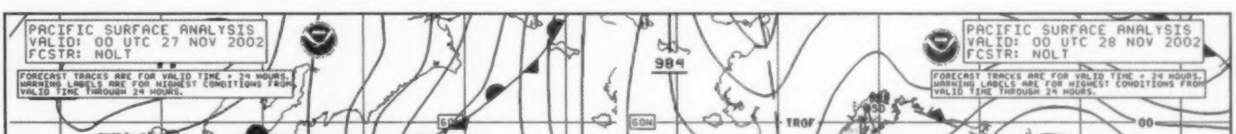

Figure 3. OPC North Pacific Surface Analysis charts valid 0000 UTC 27 November (Part 2) and 0000 UTC 28 November (Part 1), 2002.

and weakened, becoming extratropical 36 hours later.

Other Significant Events

North Pacific/ Bering Sea Storm 22-25 September: This system came from south of Japan at 0000 UTC 22 September when it was already a 988-hPa gale-force low. The center tracked north and intensified after 0000 UTC 23 September. The cyclone reached a maximum intensity of 956 hPa at 0600 UTC 25 September near 53N 180, unseasonably strong for so early in the fall season. OPC analyzed it as a hurricane-force low at 0000 and 0600 UTC 25 September, the first of the season for non-tropical systems. There were several reports of winds 50 kt or higher around this storm from the 23rd to the 25th, the highest being a 55 kt southeast wind from the ship **VBN5979** near 56N 166W at 1800 UTC 25 September. The system then weakened and passed inland over Alaska on 28 September.

North Pacific Storm 26-29 October: This storm was one of two systems of similar intensity to affect the central North Pacific during middle to late October. Both attained central pressures as low as 962 hPa. The one with the strongest winds took a more southern track along 40N and rapidly intensified after passing the dateline. By 0000 UTC 27 October, the center was at 41N 168W with a pressure of 973 hPa, down 35 hpa in 24 hours, certainly qualifying this as a meteorological "bomb." The center at 1200 UTC 27 October was down to 962 hPa near 43N 163W. Satellite data (QuikScat scatterometer winds) taken about four hours later revealed hurricane-force winds of up to 70 kt around the west and northwest sides of the center. There was little ship data around this system. The storm then moved north along 160W before turning northwest into the

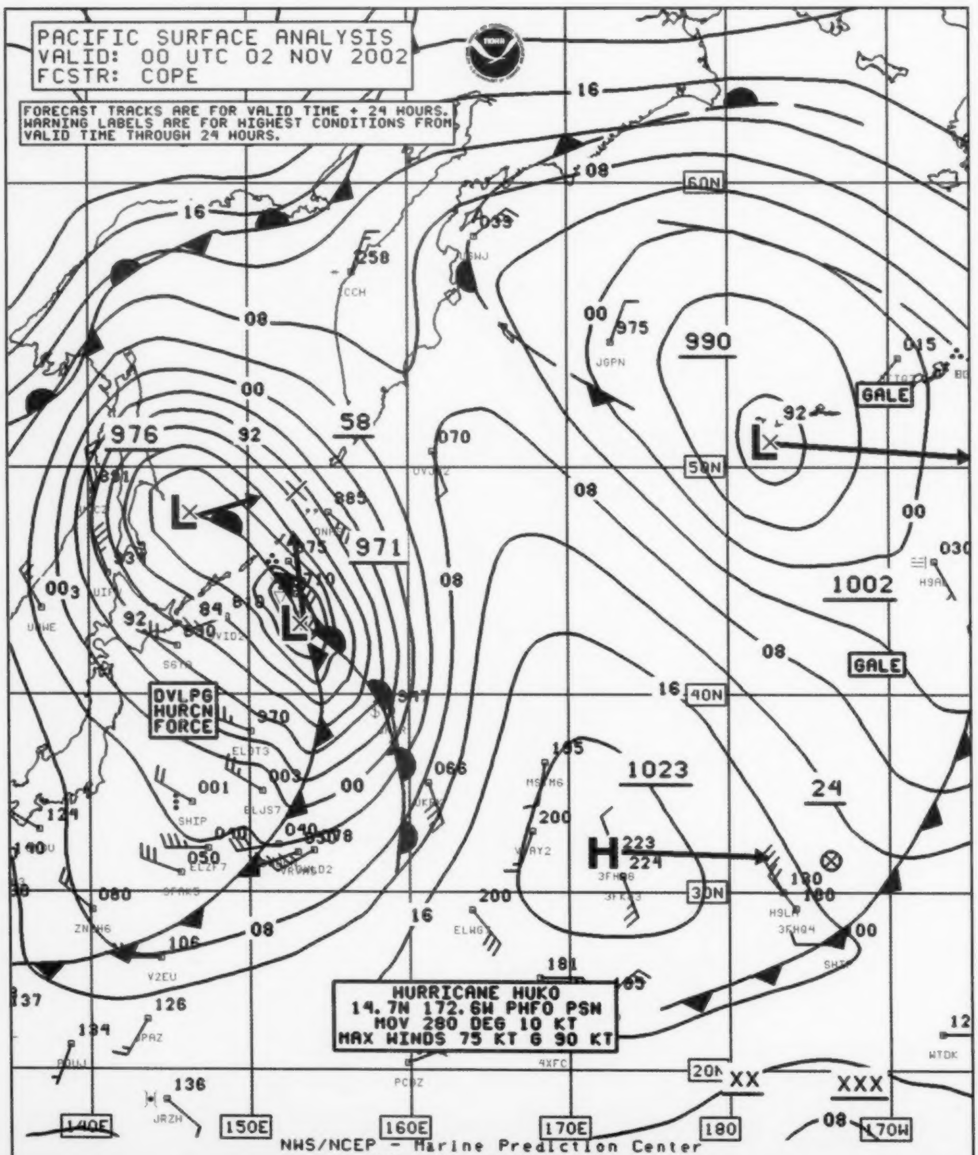

Figure 4. OPC North Pacific Surface Analysis chart (Part 2) valid 0000 UTC 2 November 2002.

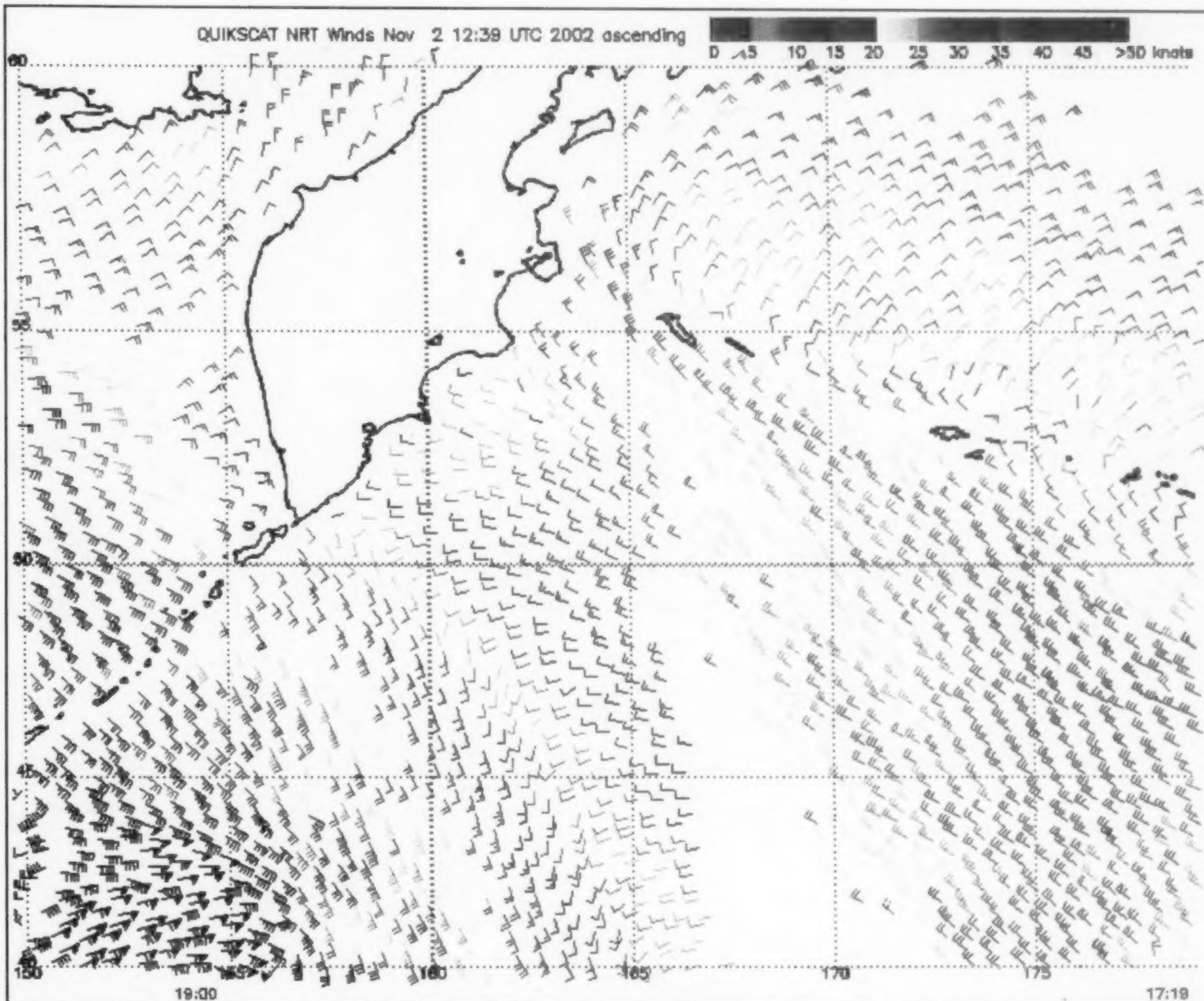

Figure 5. QuikScat scatterometer image of satellite-sensed winds around the north side of the storm shown in Figure 4. The valid time of the pass is 1900 UTC 1 November 2002. The center of the storm is off the lower left edge of the image.
(Image is courtesy of NOAA/NESDIS/Office of Research and Application)

Bering Sea and weakening on 29 October.

Western Pacific Storms, early November: Low pressure developed just south of Japan at 0000 UTC 1 November and instead of heading east or northeast like preceding October systems, turned north while rapidly deepening, becoming a compact 971-hPa low 24 hours later (***Figure 4***). ***Figure 5*** is a QuikScat pass taken about five hours prior, suggesting hurricane-force winds. The 90 kt wind barbs in ***Figure 5*** may be unreliable, contaminated by heavy rain. At the time of the surface analysis in ***Figure 4***, the **Svend Maersk** (OYJS2) just north of the center observed a southeast wind of 60 kt . The system then moved to 59N 153E at 1800 UTC 2 November, when it reached a maximum intensity of 958 hPa. The vessel **UERK** near 47N 141E reported a north wind of 60 kt, while **DHOLN** (33N 150E) observed south winds of 50 kt and 9.8-m seas (32 ft) at this time. The system then stalled and weakened near the Kurile Islands. Another low-pressure system followed on a similar track about a week later, developing a 956-hPa central pressure over the southeastern Sea of Okhotsk at 0000 UTC 10 November before stalling and weakening. The ship **SIWN** (47N 154E) reported southwest winds of 60 kt at 0000 UTC 10 November.

Eastern Pacific Storm 4-16 November: This low formed about

600 nmi east of Japan early on 4 November and tracked east near 45N with gradual intensification, becoming a hurricane-force low near 46N 145W at 1800 UTC 6 November. The lowest central pressure was 952 hPa when the center was at 47N 142W at 0600 UTC 7 November. Six hours later, NOAA Buoy 46006 near 41N 137W observed west winds of 43 kt with gusts as high as 58 kt and seas as high as 14.0 m (46 ft). To the east, NOAA buoy 46002 near 42N 130W reported southwest winds of 31 kt with gusts to 49 kt and seas of 12.5 m (41 ft) at 2100 UTC 7 November. The storm then drifted north and slowly weakened, before dissipating west of the Queen Charlotte Islands on the 11th. At that time a second low formed to the south near 39N 143W (996 hPa) and moved northeast to 51N 135W at 1200 UTC 12 November (971 hPa), when the **Westwood Borg** (LAON4) reported a southeast wind of 70 kt near 52N 131W. This system then moved into the Gulf of Alaska and weakened on the 13th. Another low followed on the 15th and 16th, moving into the coast of British Columbia with a 982-hPa central pressure on 16 November.

North Pacific Storm of 15-18 November: A developing low moved northeast from the Kurile Islands on the 15th and developed into a compact hurricane-force storm (968 hPa) near 49N 171E at 0600 UTC November 17. The **SeaLand Argentina** (DGVN), near 46N 170E, encountered west winds of 65 kt at that time. The system developed a 961-hPa central pressure near the eastern Aleutians early on the 18th before turning north and weakening by 20 November.

North Pacific Storm 21-23 November: This low underwent impressive intensification, starting as a weak 1015-hPa low near 37N 148E at 0000 UTC 21 November and, after absorbing another low to the north, deepened to 972 hPa near 49N 159E at 0000 UTC 22 November. This was a drop of 43 hPa in central pressure in 24 hours. The center reached a maximum intensity of 966 hPa near 49N 161E at 0600 UTC 22 November. QuikScat data obtained about 18 hours later showed a swath of 50 to 65 kt winds southwest of the center. The storm then drifted southeast and weakened to a gale by 24 November.

North Pacific Storm 1-5 December: This developing low moved northeast from south of Japan and accomplished much of its intensification in the 24-hour period ending at 0000 UTC 3 December. The system developed into a hurricane-force low near 43N 176E (970 hPa) at 1200 UTC 3 December. The ship **ELXZ9** near 39N 171E reported a west wind of 60 kt at that time. Scatterometer data (QuikScat) for 0700 UTC that day showed winds as high as 75 kt south of the center near 38N. The system turned north and weakened rapidly after reaching 48N 171W, with a 963-hPa central pressure at 0000 UTC 5 December.

Western Pacific Storm 10-12 December: Two lows, one near the Kurile islands and the other to the south near 39N at 1200 UTC 10 December, merged to

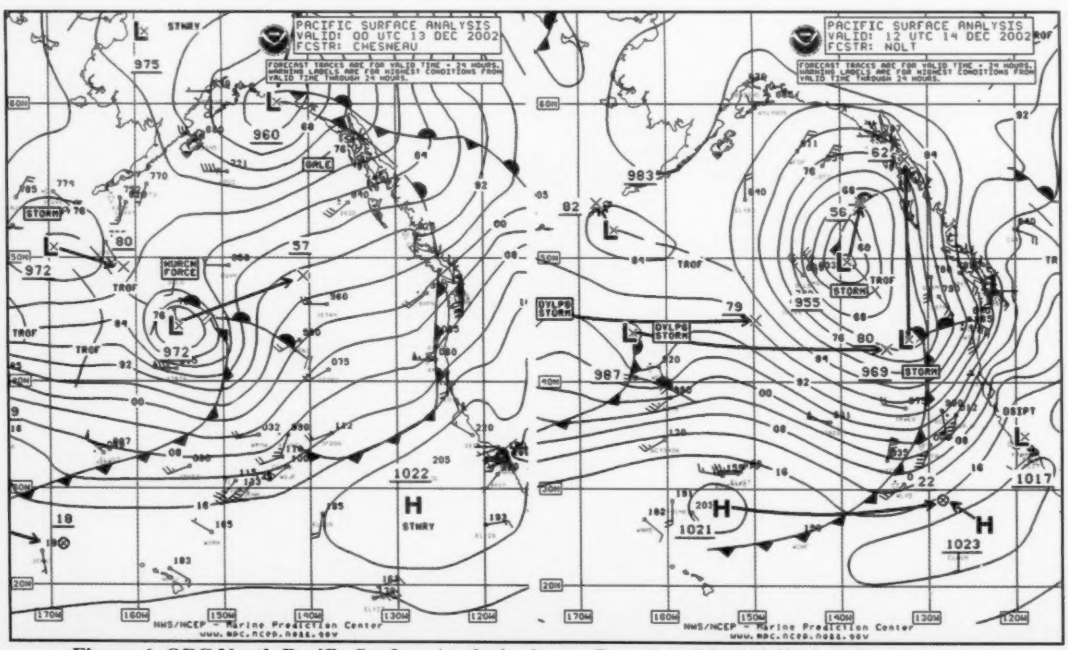

Figure 6. OPC North Pacific Surface Analysis charts (Part 1) valid 0000 UTC 13 December and 1200 UTC 14 December 2002.

form a compact 970-hPa hurricane-force low near 48N 161E at 1800 UTC 11 December. The ship **C6NI7** west of the center near 47N 156E observed west winds of 65 kt. QuikScat data taken near that time revealed winds as high as 70 kt south of the center near 45N. The system subsequently moved east and weakened, and dissipated south of the eastern Aleutians on 13 December.

Eastern Pacific storms 11-16 December: A series of fast-moving lows and trailing fronts affected the waters off the U.S. Pacific Northwest and British Columbia. The 36-hour period shown in ***Figure 6*** is an example of a portion of this active pattern. The 972-hPa hurricane-force low near 44N 155W had a report from the **SeaLand Eagle** (V7AZ8) to the south of the center with a west wind at 75 kt. This report appeared reliable and supported by scatterometer data. The low moved northeast and became the 955-hPa low off Vancouver Island in the second part of ***Figure 6***. Meanwhile a secondary storm formed to the southeast (969 hPa) and moved north, and yet another developing storm appeared well to the west, heading east. The secondary low intensified to 952 hPa near 52N 136W at 0600 UTC 15 December before moving north and weakening. The developing storm (987 hPa) in the second part of ***Figure 6*** deepened to 960 hPa near 49N 131W 36 hours later. The **Westwood Marianne** (C6QD3) near 49N 127W reported a south wind of 65 kt at 0000 UTC 16 December, while **SCFH** to the south near 36N 133W observed south winds of 60 kt. NOAA Buoy 46022 (40.7N 124.5W) reported the highest wind among buoys, a southeast wind of 49 kt with gusts to 60 kt at 1600 UTC 14 December, with a peak gust of 66 kt. Destruction Island near the Washington coast reported a southeast wind of 53 kt with gusts to 64 kt at 1700 UTC 14 December, and a peak gust of 75 kt one hour later. NOAA Buoy 46002 (42.5N 130.3W) reported seas as high as 11.5 m (38 ft) at 1900 UTC 15 December.

Western Pacific/Bering Sea storms, late December: Two intense lows, both with central pressures below 950 hPa, developed in the western North Pacific and Bering Sea after mid-December. The first formed near Japan on the 16th and moved northeast, developing a lowest pressure of 946 hPa near 54N 175E at 1800 UTC 18 December. The **President Grant** (WCY2098) near 39N 161E reported west winds of 60 kt at 1800 UTC 17 December. At 0600 UTC 19 December, the **Polar Eagle** (ELPT3) observed west winds of 60 kt near 54N 179W. The low then turned northwest and weakened. The following low was stronger and followed a similar track as shown in ***Figure 7***, over a 48-hour period ending at 1800 UTC 27 December. The period of most rapid intensification was from 0000 UTC 26 December to 0000 UTC 27 December when the central pressure dropped 41 hPa. The second part of ***Figure 7*** shows the low at maximum intensity with a pressure of 939 hPa, the lowest pressure reached by

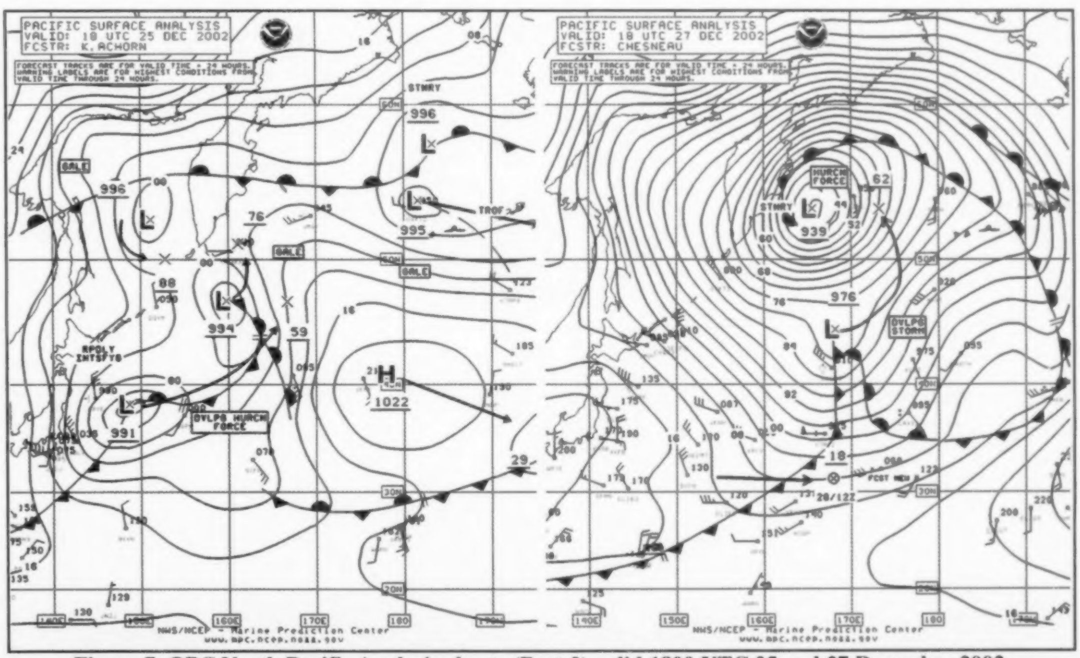

Figure 7. OPC North Pacific Analysis charts (Part 2) valid 1800 UTC 25 and 27 December 2002.

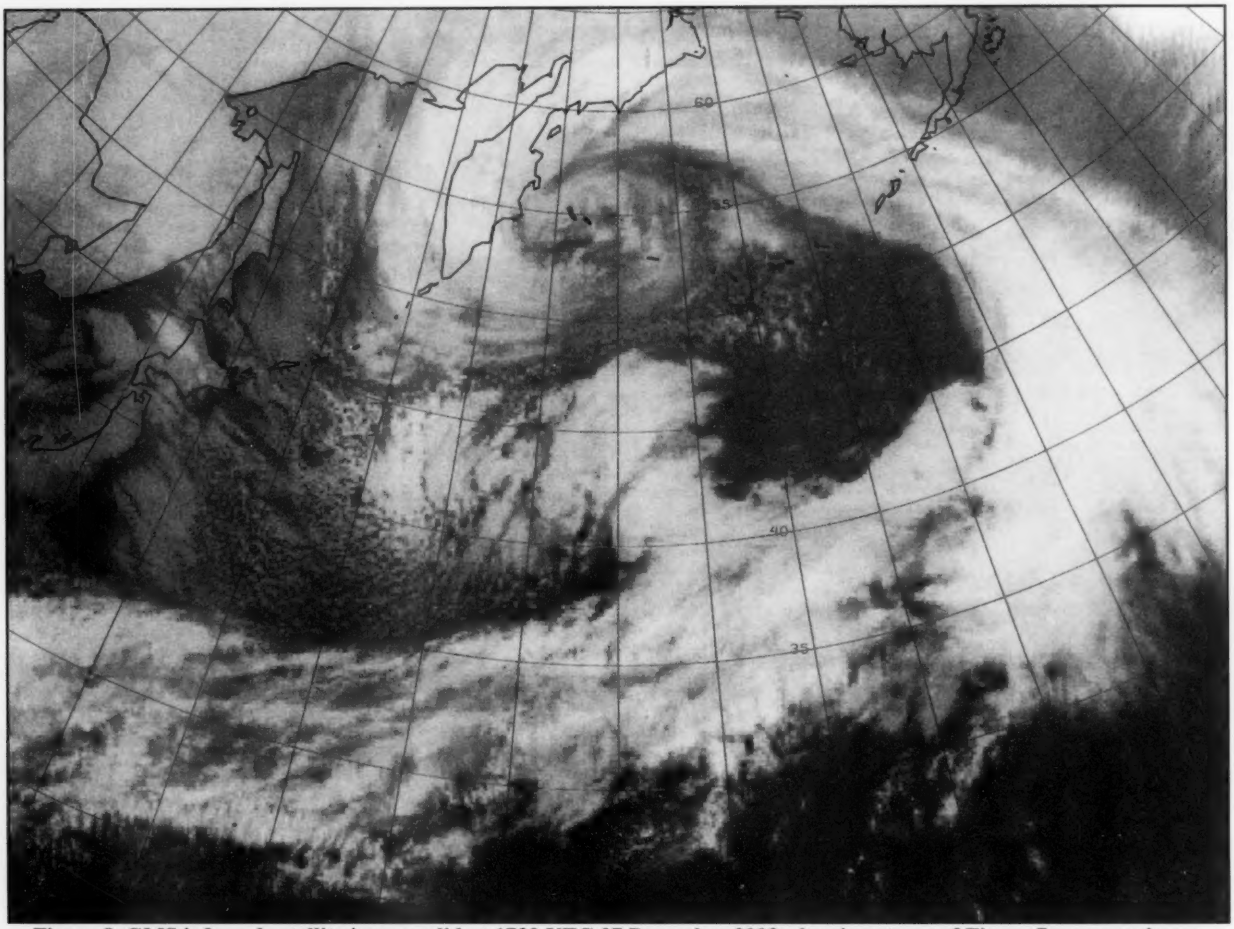

Figure 8. GMS infrared satellite image valid at 1732 UTC 27 December 2002, showing storm of Figure 7 near maximum intensity. Satellite senses temperature on a scale from warm (black) to cold (white) in this type of imagery.

any non-tropical low during the six-month period in either ocean. The satellite image in ***Figure 8*** shows the low at maximum intensity, with high-topped clouds wrapping around the center and a cloud system covering much of the North Pacific west of 150W. The ship **PCIM** at 49N 160E observed a west wind of 50 kt at 0600 UTC 27 December. On the other hand, the QuikScat image in ***Figure 9*** taken about at the same time shows

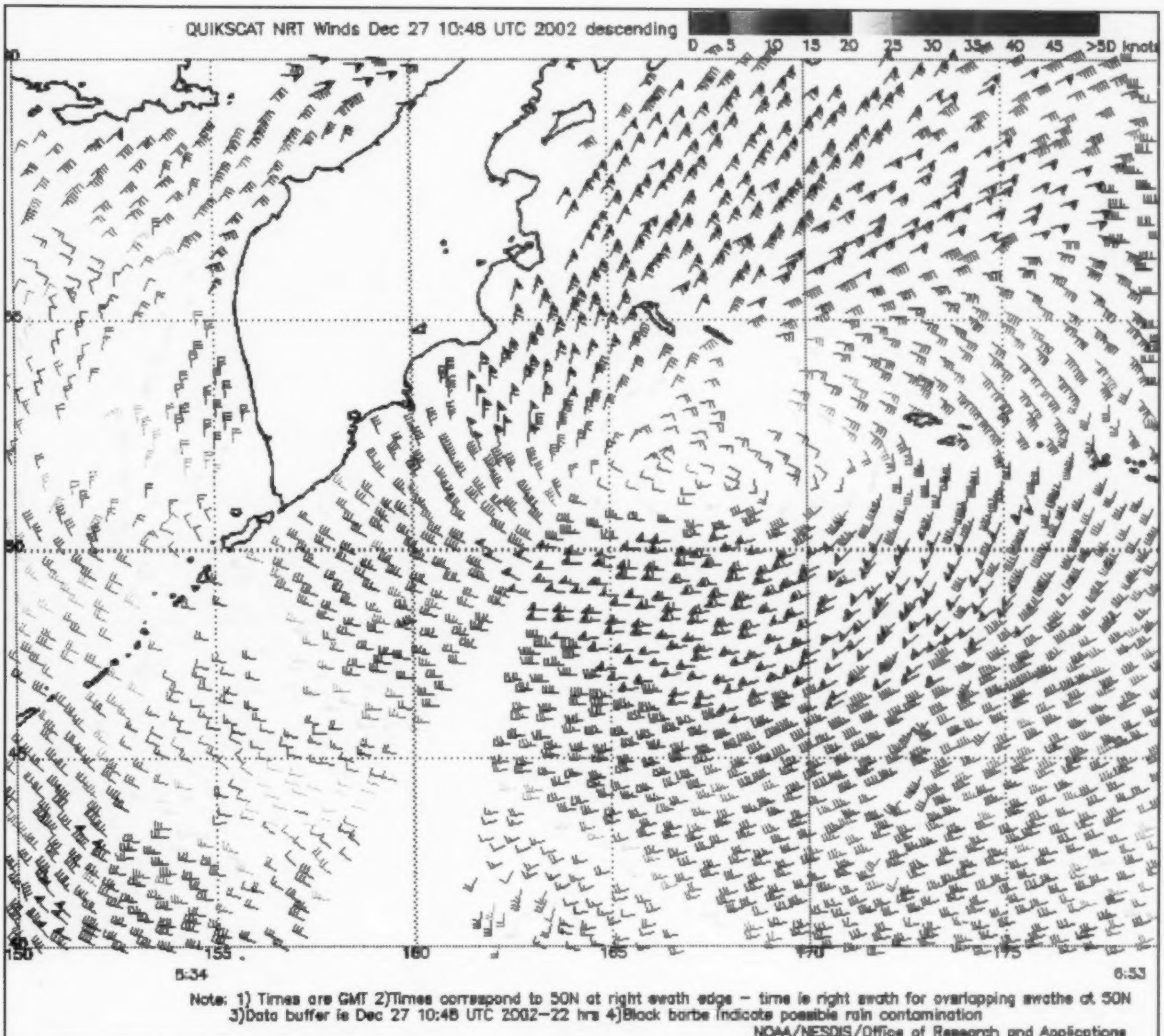

Figure 9. QuikScat scatterometer image of remotely-sensed winds obtained via satellite. Valid time is 0834 UTC 27 December 2002.

(Image courtesy of NOAA/NESDIS Office of Research and Applications)

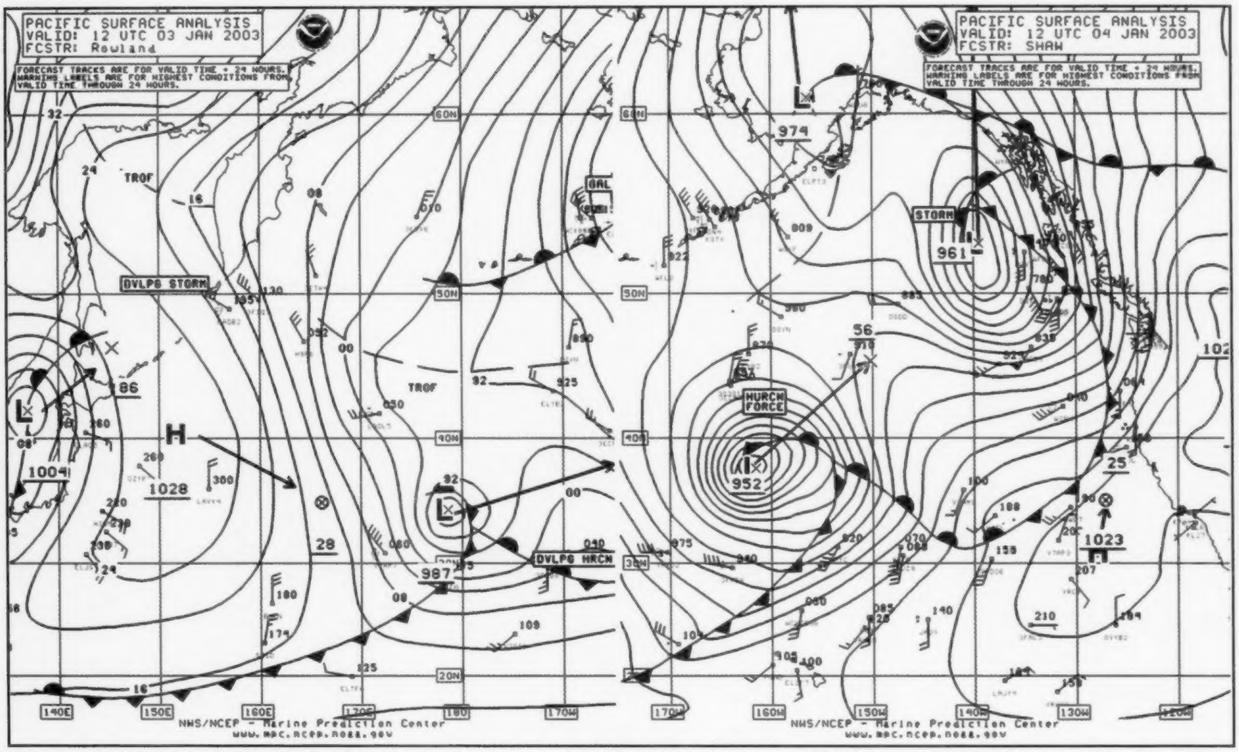

Figure 10. OPC North Pacific Surface Analysis charts valid 1200 UTC 3 January (Part 2) and 1200 4 January (Part 1) 2003.

numerous wind barbs in the 60 to 70-kt range around the north, northwest and south sides of the center, in an area of sparse ship observations. The low subsequently drifted southwest and weakened.

North Pacific Storm of 3-5 January: The southern branch of the jet stream was active from January into the first half of February, contributing to several storms that produced hurricane-force winds. The strongest of these tracked east along 35N and developed storm force winds upon reaching the dateline, and then hurricane-force winds by 0600 UTC 4 January as the center reached 37N 166W with a 956-hPa central pressure, down 39 hPa from 24 hours prior. This was an unusually deep low and rapid rate of deepening given the relatively far-south location. ***Figure 10*** depicts the low during rapid development. The impressive satellite image in ***Figure 11*** shows a well-defined circulation of cold-topped clouds around the center

Figure 11. Infrared satellite image of the storm shown in Figure 10, with a valid time of 1115 4 January 2002. Image is composite of GMS and GOES satellite image.

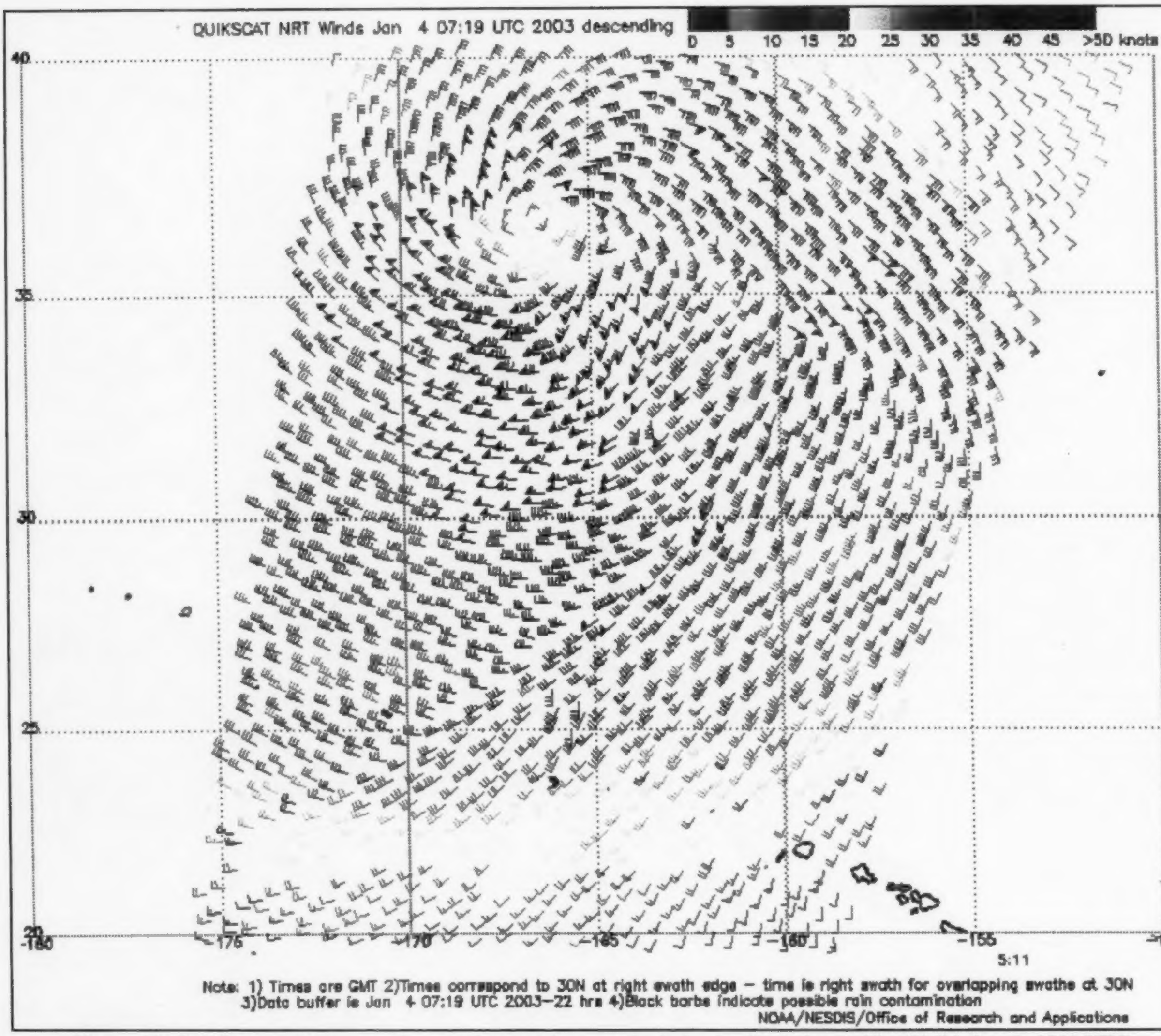

Figure 12. QuikScat scatterometer image of remotely-sensed winds obtained via satellite. Valid time is 0511 UTC 4 January 2004.

(Image courtesy of NOAA/NESDIS Office of Research and Applications)

and general comma-shaped cloud pattern, much more compact than the late December storm. Available ship data were around the periphery of the low and had winds mostly 50 kt or less. The QuikScat image in ***Figure 12*** reveals winds as high as 85 kt south of the center near 34N. The cyclone subsequently turned north-northeast with a gradual weakening trend, and moved into mainland Alaska early on 6 January.

North Pacific Storm 16-20 February: This system started on a southern track similar to that of the early January storm, but due to increased blocking over the eastern Pacific, was forced to turn north along the dateline (***Figure 13***). The central pressure bottomed out at 950 hPa near 47N 179W at 1200 UTC 18 February. The highest wind reported by a ship was a west wind of 55 kt from **LAJV4** (42N 178W) at 0000 UTC 20 February. A QuikScat image taken about four hours after the map time of ***Figure 13*** showed a small area of winds 65 to 70 kt south of the center. The system weakened after 0000 UTC 19 February and then dissipated over the Bering Sea on 22 February. ⚓

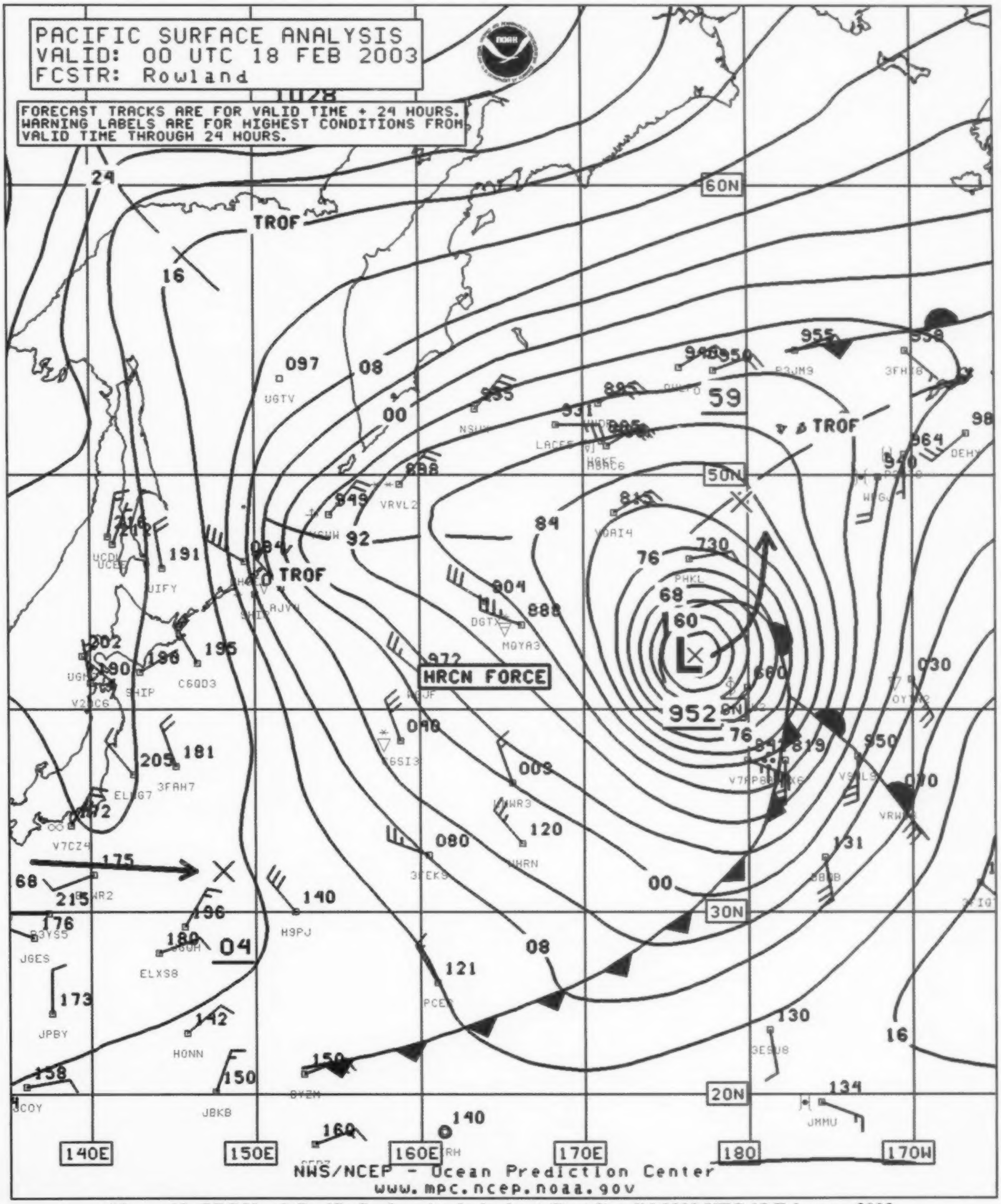

Figure 13. OPC North Pacific Surface Analysis chart (Part 2) valid 0000 UTC 18 February 2003.

Marine Weather Review Tropical Atlantic and Tropical East Pacific Areas - September through December 2002

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Atlantic, Caribbean and Gulf of Mexico

It seems that the El Niño pattern that became established in the fall of 2002 was in part responsible for the development of low pressure centers over the southeastern United States or along the northern Gulf of Mexico. Two of these lows produced gale force winds over portions of the Gulf in November and early December. In late December, a strong cold front produced a prolonged period of gales over much of the subtropical Atlantic.

Gulf of Mexico and West Atlantic Cold Front 16-17 November: On 15 November, a cold front entered the northwestern Gulf of Mexico and moved slowly southeast. Early on the 16th, a low formed along the front over the north central Gulf and then moved northeast to the Florida panhandle. The pressure gradient tightened over the western Gulf as a strong high built southward behind the front. Northwesterly winds reached gale force shortly before 1200 UTC 16 November. At 1200 UTC, NOAA buoy 42002 near 25N 94W reported northwest winds of 36 kt. Sea heights at the buoy quickly rose to 4 m (13.5 ft). The **P&O Nedlloyd Vera Cruz** (PGFE) near 27.5N 94W encountered 35 kt winds at 1800 UTC. Along the Mexican coast, Veracruz observed sustained gale force winds for several hours. The sustained winds at Veracruz peaked at 60 kt with gusts to 80 kt, and the visibility dropped to 2 miles in blowing sand.

By 0600 UTC 17 November, the front extended from just east of Jacksonville, Florida to the Yucatan channel, while the high pressure was centered over southern Texas. At this time, winds began to decrease over the western Gulf of Mexico but remained above gale force over the central and east Gulf northwest of the front. Two ships, the **Mormacsun** (WMBK) and **KMRH** observed northerly winds of 35 kt along 26N between 87W and 90W. These observations verified the winds at NOAA buoy 42003 (26N 86W) which reported sustained winds of 35 kt with gusts to 45 kt between 0600 UTC and 1200 UTC. Sea heights at the buoy peaked at 4.3 m (14 ft). Over the western Atlantic, southwesterly winds increased to gale force north of 29N east of the front.

By 1200 UTC 17 November, the high pressure center moved into northern Mexico. This event also produced storm force (>48 kt) winds in the Gulf Tehuantepec (see Eastern North Pacific section below). Winds over the eastern Gulf of Mexico remained near gale force until 1800 UTC, then began to slowly decrease. However, over the western Atlantic, NOAA buoy 41010 (29N 78.5W) reported 36 kt winds with gusts to 46 kt and seas of 4.5 m (15 ft) just ahead of the front. Winds over the western Atlantic decreased below gale force by 0000 UTC 18 November.

Gulf of Mexico Cold Front 5-6 December: Shortly before 1800 UTC 4 December, a cold front moved off the Texas coast into the northwestern Gulf of Mexico. By 0600 UTC 5 December, the front extended from near Pensacola, Florida to the southwest Bay of Campeche. Strong high pressure centered over the southern Plains built southward behind the front. As this happened, northerly winds increased to gale force over the southwestern Gulf, mainly along the coast of Mexico. QuikSCAT data from 1235 UTC indicated 30 to 35 kt winds south of 25N west of 95W.

By 1200 UTC 6 December, the 1030 hPa high was centered over south Texas. A 1203 UTC QuikSCAT pass continued to reveal 30 to 35 kt winds over the southwest Bay of Campeche. Later on 6 December, the high began to move east-northeast across the southeastern United States. The pressure gradient relaxed, and winds decreased below gale force by 0000 UTC 7 December. This event also produced storm force winds in the Gulf of Tehuantepec (see Eastern North Pacific section).

Atlantic Cold Front 25-28 December: At 0000 UTC 25 December, a cold front approached the southeastern U.S. coast while a low pressure center intensified along the coast of the Carolinas. Ahead of the front, southwesterly gales occurred along the Georgia and north Florida coast. Buoy 41010 reported southwest winds of 31 kt with gusts to 40 kt at 1000 UTC. At 1200 UTC 25 December, the 994 hPa low pressure

center was located along the North Carolina coast with the front trailing south through 31N 77W to just north of West Palm Beach, Florida. West of the front, the winds also increased to gale force, and the ship **Naparima** (3FMM6) near 31N 78W encountered westerly winds of 40 kt. Just east of the front, NOAA buoy 41002 (32N 75W) reported 39 kt winds with gusts to 46 kt at 1300 UTC. At 1800 UTC, the **Argonaut** (KFDV) observed west winds of 35 kt near 30N 78W. Sea heights at buoy 41002 peaked at 7 m (23 ft) at 1900 UTC. QuikSCAT data from 2259 UTC revealed an area of 30 to 35 kt winds north of 28N west of 65W.

At 0000 UTC 26 December, the low deepened into a 973 hPa storm center off the coast of New England. The front extended southward from the low through 31N 68W to central Cuba. By 1200 UTC 26 December, the low was producing hurricane force winds well north of the area while the trailing front extended through 31N 60W to east-central Cuba. Gale force winds continued north of 29N between 52W and 70W. At 0000 UTC 27 December, the front extended through 31N 53W to extreme eastern Cuba. Shortly thereafter, the ship **Endeavor** (WAUW), just east of the cold front, encountered southwest winds of 35 kt and seas of 6 m (19 ft) near 30N 51W. By 1200 UTC, winds decreased below gale force west of the front. However, the combination of the front and a strong high over the eastern Atlantic continued to produce southwesterly gale force winds north of 29N within 300 nmi east of the front. The ship **Looiersgracht** (PFPQ) confirmed the gale force winds as it observed 35 kt southwest winds near 31N 40W at 0000 UTC 28 December. By 1200 UTC, the weakening front extended along 31N 40W to the north coast of Hispaniola. At this time winds finally decreased below gale force.

Eastern North Pacific

Beginning in early November 2002, the Gulf of Tehuantepec produced a large number of gale and storm events. ***Table 1*** is a list of the beginning and ending times of Gulf of Tehuantepec gale or storm events from November and December 2002.

The Tehuantepec events in the fall of 2002 were the result of low pressure systems that formed in the Gulf of Mexico or over the southeast United States. These lows drove several cold fronts well south. Following the fronts, strong high pressure centers moved into south Texas or northern Mexico. The resulting pressure gradient then produced gale or storm force winds over the Gulf of Tehuantepec. In November, five Tehuantepec events occurred, including one of the strongest events that has been captured in QuikSCAT data. Six additional events occurred in December, including one storm event early in the month. The Tehuantepec events were verified by either reliable ship observations or timely QuikSCAT data.

Gulf of Tehuantepec Storm: 17-19 November: This event began after a strong cold front moved across the Gulf of Mexico on the 16-17 November. The front produced gale force winds over the Gulf of Mexico (see Atlantic section). The wind event began around 0000 UTC 17 November, as northerly gale force winds reached the Gulf of Tehuantepec. QuikSCAT data from 0050 UTC 17 November confirmed the presence of gale force winds by detecting 35 to 45 kt in the Gulf of Tehuantepec. The ship **DHOLN** near 13.5N 95.5W observed 35 kt winds at 0600 UTC.

Preceding the event, the high pressure over the western plains was not as strong as in many other Tehuantepec

Event	Beginning	Ending
1	0000 UTC 07 November	1800 UTC 08 November
2*	0600 UTC 13 November	1800 UTC 14 November
3*	0000 UTC 17 November	0000 UTC 19 November
4	0000 UTC 20 November	0000 UTC 24 November
5	0600 UTC 28 November	1200 UTC 30 November
6	0600 UTC 01 December	1800 UTC 02 December
7*	0600 UTC 06 December	1200 UTC 08 December
8	0000 UTC 14 December	1200 UTC 15 December
9	1200 UTC 20 December	1800 UTC 21 December
10	0600 UTC 25 December	1200 UTC 26 December
11	0000 UTC 28 December	0600 UTC 30 December

Table 1. Gulf of Tehuantepec Gale and Storm Events November - December, 2002. Estimated beginnning and ending times for Gulf of Tehuantepec gale and storm events from November to December 2002.
Storm events are denoted with an asterisk (*)

events. However, during this event the high was driven unusually far south, down the coast of Mexico. At 1200 UTC 17 November, the high was centered near Tampico, Mexico with a pressure of 1030 hPa (***Figure 1***). By this time, winds reached storm force over the Gulf of Tehuantepec. A QuikSCAT pass from 1152 UTC indicated 50 to 55 kt winds, and satellite imagery from the same time detected a large arc cloud moving southwest—away from the Gulf of Tehuantepec. The arc cloud defined the leading edge of the wind surge as seen in QuikSCAT data (***Figure 2***).

The subsequent QuikSCAT pass about 12 hours later continued to show a large area of storm force winds. The higher resolution QuikSCAT data from the 0024 UTC 18 November pass again detected a large area of 50 to 55 kt winds and a small area of 60 kt winds. These winds are possibly the strongest winds that QuikSCAT has detected in the Gulf of Tehuantepec since it began routinely providing ocean surface winds in the fall of 1999. Winds over the Gulf of Tehuantepec decreased below storm force by 1200 UTC 18 November. At that time the high pressure center had moved northeast and was centered over north Florida. Shortly after 1200 UTC, winds decreased below gale force in the Gulf.

Overall, the event was well forecast by numerical forecast models and by forecasters at the Tropical Analysis and Forecast Branch (TAFB) of the TPC. TAFB issued a storm warning about 36 hours prior to the onset of storm force winds.

Additional Gulf of Tehuantepec Events: The first Tehuantepec gale event of the fall season began just before 0600 UTC 7 November. Later that day, a 2341 UTC QuikSCAT pass detected 40 kt winds in the Gulf of Tehuantepec. There were no ship observations of gale force winds during this event. However, the ship **Sealand Racer** (V7AP8) located well south of the Tehuantepec observed 30 kt winds at 0000 UTC 8 November. The event ended around 1800 UTC 8 November.

The next event was the first storm event of the season.The event began around 0600 UTC 13 November. This event was verified by QuikSCAT data, as no ship observations of gale or storm force winds were available. QuikSCAT data detected gale to storm force winds of 40 to 50 kt at 0027 UTC 14 November. The event ended around 1800 UTC later that day.

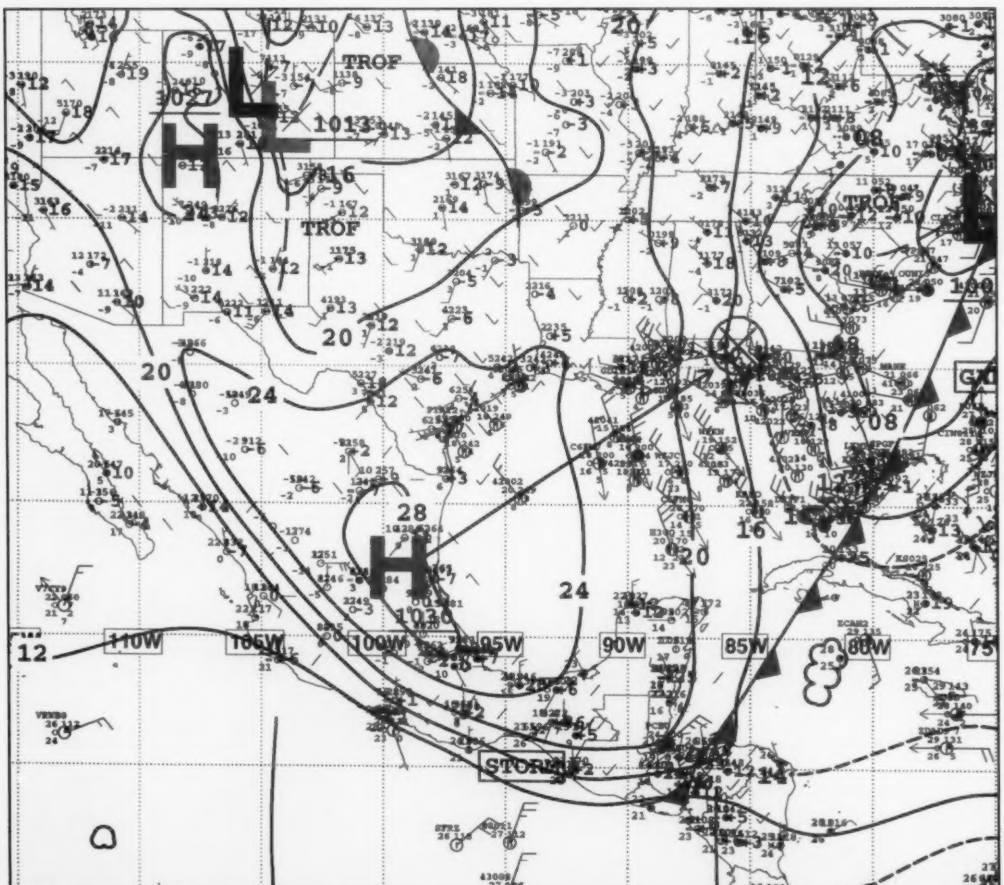

Figure 1. Surface Analysis at 1200 UTC 17 November, 2002. Note the high pressure center over eastern Mexico.

The third event of the season was the very strong storm event summarized above.

The fourth event was rather prolonged, lasting four days. Gale force winds began at approximately 0000 UTC 20 November and ended around 0000 UTC 24 November. Several QuikSCAT passes denoted 35 to 40 kt winds during the event. At least one QuikSCAT pass revealed winds as high as 45 kt. The ship **Christoforo Colombo** (ICYS) encountered 40 kt winds at 1800 UTC 21 November.

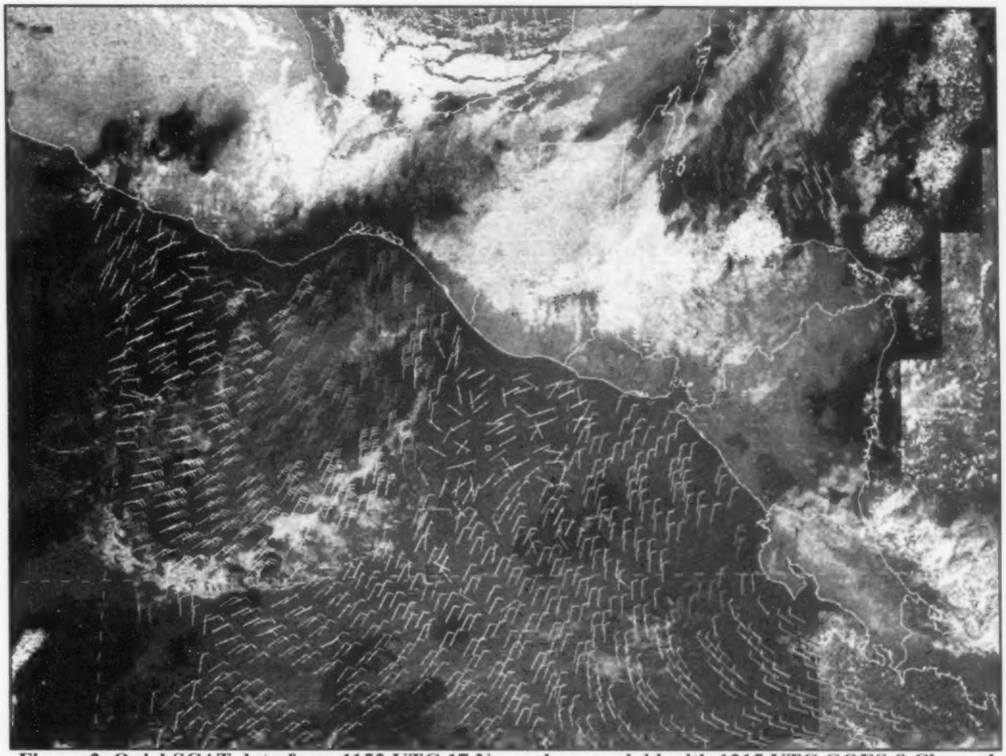

Figure 2. QuickSCAT data from 1152 UTC 17 November overlaid with 1215 UTC GOES-8 Channel 2 satellite imagery. Note, the large arc-cloud along the leading edge of the northerly wind surge.

The last event in November began 0600 UTC 28 November and ended 1200 UTC 30 November. During this event the ship **P3JZZ** observed 35 kt winds in the Gulf of Tehuantepec at 0600 UTC 29 November.

The first of six events in December began just before 0000 UTC 1 December. Two QuikSCAT passes between 0000 UTC and 1200 UTC 1 December detected 30 to 35 kt winds in the Gulf of Tehuantepec. The event ended about 1800 UTC 2 December.

The next event was the third storm event of the fall season. It began between 0000 and 0600 UTC 6 December. At 1200 UTC, the ship **C6FD6** (name unknown) located just southeast of the Gulf of Tehuantepec observed 35 kt winds. QuikSCAT data from near that time revealed storm force winds over the Gulf. A subsequent QuikSCAT pass from 0035 UTC 7 December also detected 40 to 50 kt in the area. Later that night, the **Royal Princess** (GBRP) encountered 45 kt winds while crossing the Gulf of Tehuantepec. QuikSCAT data indicated that storm force winds ended by 1200 UTC 07 December; however, gale force winds continued until 1200 UTC 8 December.

The next three events where rather short-lived events each lasting between 24 and 36 hours. The first of these events began shortly before 0000 UTC 14 December and ended at 1200 UTC 15 December. During this event QuikSCAT detected 35 to 45 kt winds at 0055 UTC 14 December and 30 to 35 kt winds at 1157 UTC (later that day). QuikSCAT revealed that winds decreased below gale force by 1200 UTC 15 December. The next short-lived event began around 1200 UTC 20 December. A QuikSCAT pass from 1217 UTC 21 December indicated 30 to 35 kt winds in the area. The event ended around 1800 UTC 21 December. The next event began shortly after 0600 UTC 25 December. A QuikSCAT pass revealed gale force winds at 1214 UTC. QuikSCAT data from 0046 UTC 26 December also detected 35 to 40 kt winds. This short-lived event ended around 1200 UTC 26 December.

The last event of 2002 began around 0000 UTC 28 December. During this event, the ship **Vega** (9VJS) observed northerly winds of 25 kt about 240 nmi south-southwest of the Gulf of Tehuantepec; however, it is assumed that stronger gale force winds occurred over the Gulf of Tehuantepec. The event ended by 0600 UTC 30 December. ⚓

Atlantic Hurricane Season of 2002

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Introduction

There were 12 named tropical cyclones in the Atlantic basin in 2002, of which 4 became hurricanes (***Table 1*** and ***Figure 1***). Two of these became major hurricanes – Category Three or higher on the Saffir-Simpson Hurricane Scale (96 kt or higher). Although the number of named storms in 2002 was above the long-term average of 10, the number of hurricanes was below the long-term average of 6. Another measure of seasonal activity, the "accumulated cyclone energy," which is the sum of the squares of the maximum wind speeds every six hours, also indicates below normal activity because there were many weak and short-lived tropical cyclones in 2002. There were also two tropical depressions that did not become storms.

Eight named tropical cyclones formed in September, making it the most active calendar month on record in the Atlantic. It is interesting that the first 2002 Atlantic hurricane did not occur until 11 September, the latest date for such an occurrence since the beginning of the reconnaissance aircraft era, 1944.

Eight tropical cyclones made direct hits in the United States. This included Lili, which was the first hurricane to make landfall in the United States since Irene in 1999. Overall, tropical cyclones caused 18 deaths. Total damage in the United States was about 1.2 billion dollars, mostly from Lili and Isidore. Isidore and Lili also caused extensive damage in western Cuba. Isidore produced extensive damage on the Yucatan Peninsula of Mexico, while Lili also caused extensive flood damage in Jamaica.

Name	Class*	Dates**	Max. winds (kt)	Min. pressure (hPa)	Direct deaths	U.S. damage ($ millions)
Arthur	Tropical Storm	July 14-16	50	997		
Bertha	Tropical Storm	Aug. 4-9	35	1007	1	
Cristobal	Tropical Storm	Aug. 5-8	45	999		
Dolly	Tropical Storm	Aug. 29-Sep. 4	50	997		
Edouard	Tropical Storm	Sep. 1-6	55	1002		
Fay	Tropical Storm	Sep. 5-8	50	998		
Gustav	Hurricane	Sep. 8-12	85	960	1	0.1
Hanna	Tropical Storm	Sep. 12-15	50	1001	3	20
Isidore	Hurricane	Sep. 14-27	110	934	4	330
Josephine	Tropical Storm	Sep. 17-19	35	1009		
Kyle	Hurricane	Sep. 20-Oct. 12	75	980		5.0
Lili	Hurricane	Sep. 21-Oct 4	125	938	9	860

Table 1. Atlantic Tropical Storms and Hurricanes of 2002.
* Tropical Storm: wind speed of 34-63 kt. Hurricane: wind speed of 64 kt or higher.
**Dates begin at 0000 UTC and include tropical depression stage (wind speed less than 34 kt).

Named Storms

Tropical Storm Arthur originated along a frontal trough in the eastern Gulf of Mexico, with the disturbance first noted on 9 July (***Figure 1***). The developing system moved northeastward and spread heavy rain across portions of north Florida, Georgia, and South Carolina. It became a tropical depression near

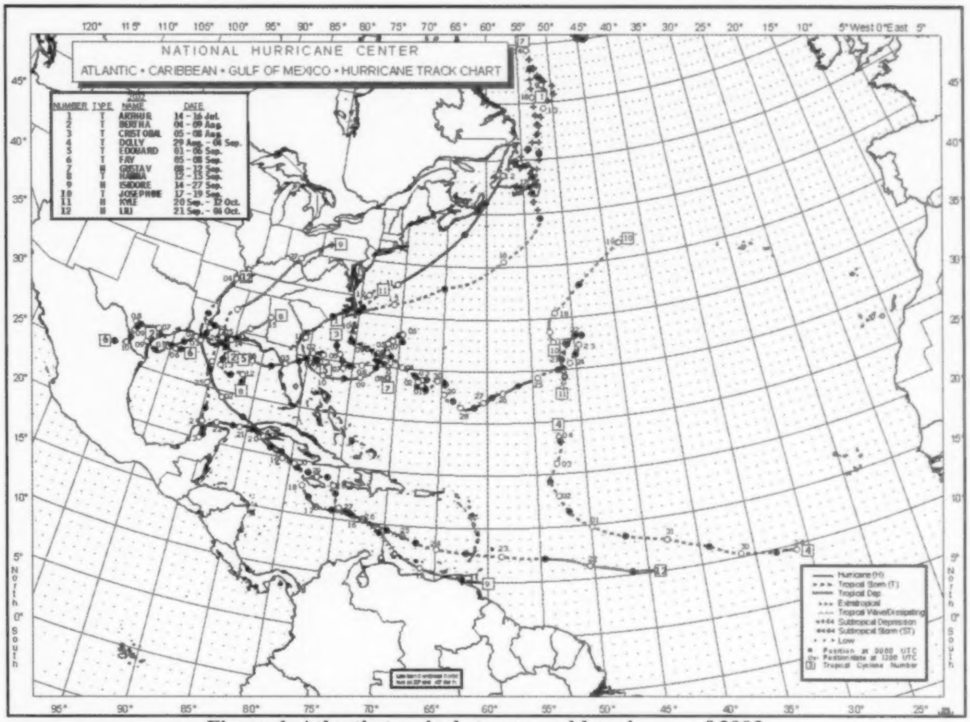

Figure 1. Atlantic tropical storms and hurricanes of 2002.

the North Carolina coast on 14 July. Arthur accelerated northeastward and reached a peak intensity of 50 kt on 16 July while centered about 350 nmi south of Nova Scotia. Arthur moved over eastern Newfoundland on the next day as it became extratropical, producing gale force winds and about one inch of rain there.

Several ships reported tropical storm winds in Arthur (***Table 2***), with the strongest being a 44-kt observation from the **Weston** (LAQF5) at 0000 UTC 16 July. Additionally, Canadian buoy 44141 reported 39-kt winds with a gust to 52 kt and a 997.5 hPa pressure at 1500 UTC that day.

Tropical Storm Bertha also formed along a frontal trough in the Gulf of Mexico. It first became a tropical depression just east of the mouth of the Mississippi River on 4 August (***Figure 1***). The cyclone quickly became a tropical storm and moved west-northwestward over southeastern Louisiana by early the next day with 35-kt sustained winds. After weakening to a depression, Bertha's center moved southwestward, back over the Gulf of Mexico on 7 August and then moved inland over south Texas on 9 August. It dissipated over land later that day.

NOAA buoy 42007 reported a 33-kt sustained wind at 2240 UTC 4 August and 0310 UTC 5 August, along with a gust to 43 kt at 0441 UTC 5 August. Waveland, Mississippi reported a gust to 36 kt.

Bertha caused rainfalls of 5 to 10 inches over portions of Louisiana and Mississippi. The storm caused one death, a drowning in high surf in the Florida panhandle near Perdido Key State Park.

Tropical Storm Cristobal formed about 150 nmi off the coast of South Carolina on 5 August (***Figure 1***), within the same trough that produced Bertha. Winds reached a maximum of 45 kt while the tropical storm meandered southward and eastward for a few days. Cristobal was absorbed into another frontal zone and dissipated on 9 September.

Two ships reported tropical storm winds in Cristobal that were considered reliable. The **Overseas Joyce** (WUQL) reported 41-kt winds at

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
16 / 0000	**Weston**	35.7	64.1	200 / 44	1011.5
16 / 0000	**Maesk Santes**	36.2	67.3	270 / 36	1011.0
16 / 1500	Buoy 44141	42.1	56.2	060 / 39G52	997.5
16 / 1800	**Betsy**	39.8	53.2	220 / 37	1011.1
17 / 0600	P6038	46.4	48.4	100 / 35	1017.0
17 / 1800	**Algofax**	45.7	59.9	xxx / 41	1011.0

Table 2. Selected ship and buoy reports with winds of at least 34 knots for Tropical Storm Arthur, 14-16 July 2002.

1200 UTC 7 August and a pressure of 1006.4 hPa three hours earlier. The **Judy Litrico** (KCKB) reported 34-kt winds at 0000 UTC 7 August.

Tropical Storm Dolly was the first storm of the season to originate from a tropical wave, becoming a tropical cyclone on 29 August at a low latitude in the far eastern Atlantic Ocean (***Figure 1***). Initially moving west-northwestward, Dolly gradually turned northward over the next five days as it moved into a weakness in the Atlantic subtropical high pressure ridge. Winds reached 50 kt on 30 August. However, strong vertical wind shear subsequently weakened the system to a remnant low on 4 September several hundred nautical miles northeast of the Leeward Islands.

Tropical Storm Edouard formed on 1 September from a non-tropical disturbance about 120 nmi east of Daytona Beach, Florida (***Figure 1***). The system made a clockwise loop off the northeast Florida coast, then headed toward Florida. Edouard unsteadily strengthened to a short-lived peak intensity of 55 kt on 3 September, but strong upper-level winds quickly caused weakening. The cyclone was barely of tropical storm intensity when it made landfall near Ormond Beach, Florida on the evening of 4 September. It crossed north-central Florida as a weak depression and then dissipated over the northeastern Gulf of Mexico on 6 September, when its remnants were entrained into the large circulation of Tropical Storm Fay centered off the Texas coast.

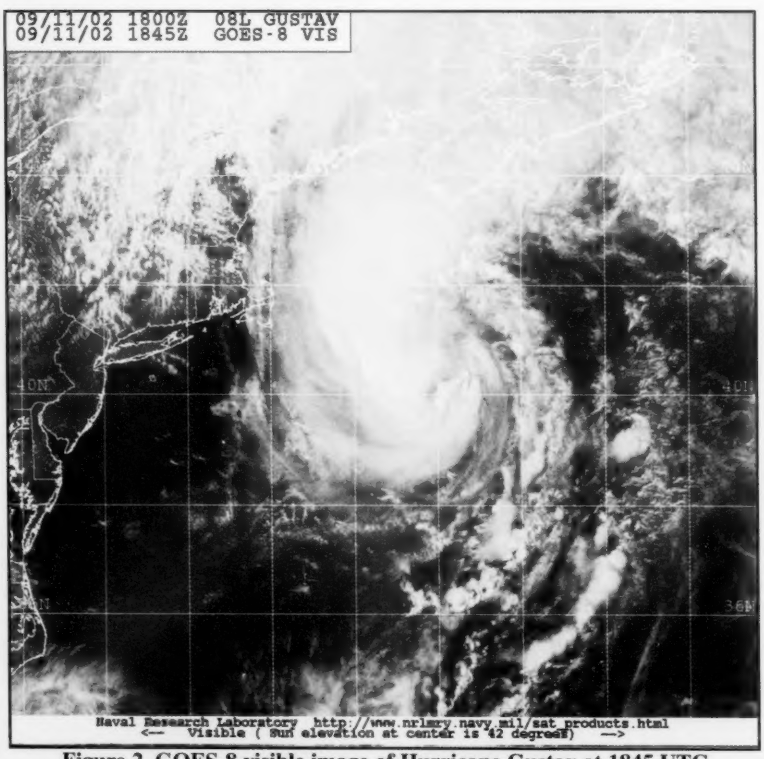

Figure 2. GOES-8 visible image of Hurricane Gustav at 1845 UTC 11 September 2002.
(Image courtesy of the Naval Research Laboratory, Monterey, CA)

A few ships encountered Edouard. The **Kent Sprint** (VGDX) reported 38-kt winds at 0900 UTC 3 September, while the **Zim Pacific** (4XFC) and the **Zim Jamaica** (4XFE) reported 36-kt and 35-kt winds at 1800 and 1200 UTC 2 September respectively. Patrick Air Force Base, Florida reported a gust to 34 kt.

Edouard caused some flooding due to locally heavy rains over north-central Florida. There were no reported casualties, and damage was minor.

Tropical Storm Fay had its origins in a broad low pressure system over the western Gulf of Mexico. Reports from an Air Force Hurricane Hunter aircraft investigating the area on 5 September suggested that a tropical depression had developed about 95 nmi southeast of Galveston, Texas (***Figure 1***). The depression quickly strengthened into a tropical storm, and Fay reached its peak intensity of 50-kt the next day. After moving slowly and erratically, Fay headed toward the Texas coast. The storm made landfall on the morning of 7 September near Port O'Connor with 50 kt winds. After landfall, Fay weakened to a remnant low that meandered across southern Texas and northeastern Mexico until finally dissipating late on 10 September near Monterrey, Mexico.

The only marine observations of tropical storm winds were from NOAA data buoys 42019 and 42035. The former reported 36-kt winds with a gust to 45 kt at 2000 UTC 6 September, along with a pressure of 999.6 hPa at 0100 UTC 7 September. The latter buoy reported a gust to 41 kt at 0300 UTC 7 September. There were numerous reports of tropical storm winds along the upper Texas coast, and there were two gusts to 80 kt near Freeport.

Fay produced widespread copious rains and several tornadoes over portions of southern Texas and northeastern Mexico. However, there were no reports of casualties, and damage was apparently minor.

Hurricane Gustav initially formed as a subtropical depression on 8 September about 440 nmi south-southeast of Cape Hatteras, North Carolina (***Figure 1***). The cyclone moved northwestward and soon became a subtropical storm. Gustav turned northward and made the transition to a tropical storm before the center passed just east of Cape Hatteras on 10 September. It then turned northeastward into the Atlantic and strengthened into the first hurricane of the season the next day. Maximum winds reached 85 kt (***Figure 2***) before Gustav made landfall in eastern Nova Scotia as a hurricane with 80 kt winds early on 12 September. The system became extratropical later that day near western Newfoundland.

Gustav affected many ships and buoys, with selected observations given in ***Table 3***. The most notable observations were from the ship **Tellus** (WRYG), which reported 88-kt and 90-kt winds at 1500 and 1600 UTC 11 September.

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
09 / 1500	**P&O Nedlloyd Sydney**	34.0	76.2	010 / 45	1010.5
09 / 1800	**P&O Nedlloyd Sydney**	34.6	75.2	030 / 37	1007.5
10 / 1800	**Star Inventana**	32.6	72.3	250 / 35	1012.4
10 / 1800	**Charles Island**	33.9	72.8	140 / 35	1003.0
10 / 1900	**Columbus Canterbury**	35.5	75.0	090 / 55	N/A
11 / 0000	**Charles Island**	33.0	74.1	250 / 40	1001.5
11 / 0310	Buoy 44001	34.7	72.7	185 / 36G46	999.0
11 / 0500	Buoy 44014	36.6	74.8	330 / 35G44	991.6
11 / 0600	WAAH	35.8	72.5	220 / 52	988.5
11 / 1420	Buoy 44004	38.5	70.5	340 / 44G62	979.0
11 / 1500	**Nedlloyd Holland**	37.8	66.9	210 / 54	990.5
11 / 1500	**Tellus**	38.0	68.1	150 / 88	978.0
11 / 1600	**Tellus**	38.0	68.2	240 / 90	982.3
11 / 1800	**Swan**	35.0	71.5	240 / 39	1003.7
11 / 2000	Buoy 44011	41.1	66.6	315 / 44G61	973.1
12 / 0000	Buoy 44142	42.5	64.0	300 / 44G60	971.5
12 / 0000	**P&O Nedlloyd Jakarta**	37.2	59.8	220 / 47	1005.0
12 / 0000	**Majestic Maersk**	40.7	61.6	220 / 40	988.0
12 / 0100	Buoy 44137	41.8	60.9	220 / 47	985.0
12 / 0300	WCY533	44.0	60.3	190 / 74	965.0
12 / 0600	Buoy 44139	44.3	57.4	210 / 41	983.3
12 / 0600	**Choyang Zenith**	37.0	59.9	230 / 41	1004.5
12 / 0600	YJRX2	44.2	59.6	240 / 55	978.7
12 / 1200	**Albatros**	44.1	63.8	320 / 48	993.2
12 / 1200	**Algofax**	46.6	59.5	290 / 43	976.0
12 / 1200	3FPK7	46.6	48.0	210 / 38	995.6
12 / 1500	HP6038	46.4	48.4	190 / 40	994.7
12 / 1800	**Kometik**	43.4	53.9	230 / 55	992.0
12 / 1800	**Atlantic Concert**	46.3	50.2	160 / 36	990.9
13 / 0300	HP6038	46.4	48.4	230 / 45	999.5
13 / 0600	**Atlantic Concert**	45.6	53.4	260 / 50	1004.2
13 / 0900	3FPK7	46.6	48.0	250 / 39	1005.7
13 / 1200	**Canmar Success**	49.7	45.7	200 / 42	1002.5
13 / 1800	**Canmar Success**	50.0	47.4	210 / 45	1005.8

Table 3. Selected ship and buoy reports with winds of at least 34 kt for Hurricane Gustav, 8-12 September 2002.

While these winds are reasonably consistent with the strength of Gustav at the time, the ship was far enough from the center that the speeds appear somewhat suspect. The oil rig WCY533 near Sable Island, Nova Scotia reported 74-kt winds and a 965.0 hPa pressure at 0300 UTC 12 September. Other noteworthy ship and buoy reports include a 55-kt wind reported by the **Columbus Canterbury** (ELUB8) near the North Carolina coast at 1900 UTC 10 September and a 964.3 hPa pressure from Canadian buoy 44142 at 2300 UTC 11 September. On land, the Cape Hatteras Coast Guard station reported a wind gust of 68 kt at 2130 UTC 10 September, and a wind gust of 66 kt occurred at Sable Island at 0414 UTC 12 September.

There was one death directly attributed to Gustav: a swimmer at Myrtle Beach, South Carolina suffered injuries from high surf and died two days later. Damage in North Carolina was estimated at about $100,000. In Nova Scotia, some docks were damaged and trees were blown down.

Tropical Storm Hanna formed in the Gulf of Mexico from the interaction of a tropical wave, an upper-level low, and a surface trough. Air Force reconnaissance aircraft observations indicate that a tropical depression developed early on 12 September about 250 nmi south of Pensacola, Florida (***Figure 1***). The system became a tropical storm early the next day. After moving slowly and erratically for a couple of days, Hanna turned northward toward the northern Gulf coast, ahead of an approaching mid-level trough. With maximum winds near 50 kt, the storm center passed over the southeastern tip of Louisiana early on 14 September and made a second landfall near the Mississippi-Alabama border later that morning. Hanna dissipated near the Alabama-Georgia border on 15 September, but its remnants continued northeastward across Georgia and the Carolinas.

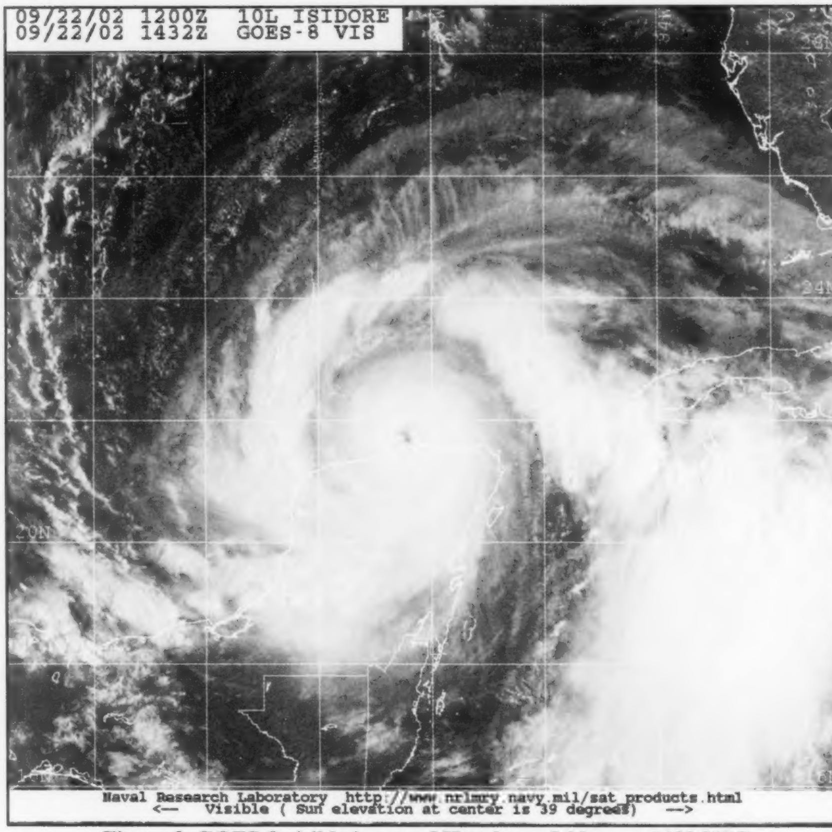

Figure 3. GOES-8 visible image of Hurricane Isidore at 1432 UTC 22 September 2002.

(Image courtesy of the Naval Research Laboratory, Monterey, CA).

The only ship to report tropical storm winds in Hanna was the **Nobel Star** (KRPP), which reported 37-kt winds and a pressure of 1006.0 hPa at 0300 UTC 13 September. NOAA buoy 42003 reported 37-kt winds at 0750 UTC 13 September, while buoy 42007 reported 35-kt winds with a gust to 43 kt at 1010 UTC 14 September.

On the coast, sustained winds of 47 kt were recorded at Pensacola, and a gust to 59 kt was measured at Pensacola Beach. Further inland, heavy rains occurred across the southeastern states with many accumulations of between 5 and 10 inches. The highest reported storm total, 15.56 inches, was from Donalsonville, Georgia. Three deaths in the Florida panhandle are attributed to rip currents generated by Hanna. The total damage, mainly agricultural losses, is estimated at $20 million.

Hurricane Isidore developed from a tropical wave into a tropical depression just east of Trinidad on 14 September (***Figure 1***), but degenerated back to a wave over the eastern Caribbean Sea the next day. The system again became a depression south of Jamaica on 17 September and

strengthened into a tropical storm early the next day. The center of Isidore just missed Jamaica, then moved west-northwestward across the Cayman Islands and strengthened into a hurricane. Maximum winds reached 90 kt while it passed near the Isle of Youth, Cuba, and Isidore hit the western tip of mainland Cuba with 75-kt winds on 20 September. After striking Cuba, the hurricane moved over the Gulf of Mexico and strengthened to 110 kt while heading toward the Yucatan Peninsula (***Figure 3***). The hurricane turned southwestward and made landfall near Puerto Telchac on the northern coast of Yucatan on 22 September. For 24 to 36 hours, Isidore meandered over the northern Yucatan Peninsula while it weakened to a 35-kt tropical storm. It then moved northward over the Gulf of Mexico and made landfall early on 26 September just west of Grand Isle, Louisiana, with maximum winds near 55 kt. Weakening over land, Isidore produced torrential rains as it moved across the southeastern states. It became an extratropical cyclone over Pennsylvania on 27 September and was then absorbed into a frontal zone.

Isidore affected many ships and buoys, especially over the Gulf of Mexico where the cyclone's circulation became very large. A selection of the numerous observations is given in ***Table 4***. The strongest winds were observed by the **Deepwater Pathfinder**, which reported 55-kt winds and a gust to 71 kt at 1743 UTC 25 September. NOAA buoy

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
19 / 0600	**Maasdam**	18.6	78.8	150 / 46	1004.0
20 / 0200	**Explorer of the Seas**	25.0	80.0	140 / 33	1012.8
20 / 0600	C6FM7	22.7	87.4	100 / 35	1006.0
20 / 2100	**P&O Nedlloyd Jakarta**	24.5	83.4	080 / 37	1005.0
20 / 2100	**Courtney L**	20.2	81.1	230 / 35	1005.1
21 / 0600	C6MF5	23.1	80.6	100 / 40	1010.2
21 / 1200	**Happy River**	20.8	83.8	150 / 39	1002.0
21 / 1200	**Rhapsody of the Seas**	24.1	87.7	050 / 38	1002.0
22 / 0000	**Levantgracht**	21.5	84.7	180 / 39	1000.0
22 / 0900	**Frances L**	23.4	85.7	100 / 44	999.4
22 / 1200	C6FM6	25.0	89.7	050 / 42	1003.0
23 / 1200	**Advantage**	26.6	89.5	090 / 40	1005.5
23 / 1500	VSCX4	26.7	90.1	070 / 37	1010.4
23 / 1500	**P&O Nedlloyd Vera Cruz**	20.0	95.5	320 / 45	1006.9
23 / 1800	**P&O Nedlloyd Vera Cruz**	19.9	95.6	310 / 41	1005.0
24 / 1100	**Bonn Express**	25.0	84.9	130 / 35	1007.3
24 / 1200	C6FM6	26.9	88.5	050 / 53	1006.0
24 / 1200	**Celebration**	27.2	90.5	040 / 44	N/A
24 / 1800	**Lykes Navigator**	27.7	89.0	090 / 44	1005.5
24 / 1800	**Discoverer Enterprise**	28.2	88.4	040 / 34	1006.0
24 / 2100	**P&O Nedlloyd Vera Cruz**	19.7	94.4	280 / 47	1002.7
25 / 0300	**Sealand Pride**	27.9	92.4	040 / 37	1005.0
25 / 0350	Buoy 42001	25.9	89.7	115 / 39G52	998.5
25 / 0700	**Bonn Express**	27.3	91.4	050 / 37	1001.2
25 / 0900	**P&O Nedlloyd Vera Cruz**	20.0	93.9	290 / 44	1004.1
25 / 0940	Buoy 42002	25.2	94.4	335 / 36G44	1001.2
25 / 0940	Buoy 42003	25.9	86.0	180 / 41G55	1004.5

Table 4. Selected ship and buoy reports with winds of at least 34 kt for Isidore, 14-27 September, 2002.
(Table continued on next page.)

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
25 / 1500	**Bonn Express**	27.6	93.1	320 / 43	1002.7
25 / 1500	VSCX4	27.5	94.4	030 / 35	1006.5
25 / 1743	**Deepwater Pathfinder**	26.5	87.7	130 / 56G71	1005.0
25 / 1800	**Overseas Harriet**	27.6	85.1	130 / 37	1008.3
25 / 1800	**Celebration**	22.8	85.1	160 / 40	1005.0
25 / 2100	C6FM7	27.8	94.1	080 / 35	999.0
25 / 2100	**R. Hal Dean**	28.9	87.2	120 / 39	1000.0
25 / 2100	LANR5	27.0	94.2	010 / 37	1001.9
25 / 2300	**Discoverer Enterprise**	26.9	86.4	160 / 45	992.0
26 / 0000	**Jo Spruce**	27.5	87.5	130 / 37	995.6
26 / 0000	**Frances L**	25.3	87.0	180 / 45	1008.5
26 / 0000	**Overseas Harriet**	27.7	85.8	130 / 38	1002.7
26 / 0030	Buoy 42040	29.2	88.2	100 / 38G40	995.1
26 / 0200	**Bonn Express**	27.5	94.9	340 / 35	1004.9
26 / 0300	**R. Hal Dean**	28.8	87.1	120 / 50	995.4
26 / 0310	Buoy 42007	30.1	88.8	090 / 46G60	995.3
26 / 0600	**Fairload**	26.6	84.4	140 / 41	1006.8
26 / 0600	**Overseas Harriet**	28.0	85.4	130 / 42	1003.5
26 / 0600	**Melbourne Star**	25.8	86.6	180 / 34	1000.8
26 / 0600	**R. Hal Dean**	28.8	87.0	140 / 49	995.0
26 / 0710	Buoy 42041	27.5	90.5	275 / 34G43	989.3
26 / 0800	Buoy 42039	28.8	86.1	140 / 36G45	998.0
26 / 1200	**Frances L**	29.2	87.6	150 / 36	994.0

Table 4. (Continued) Selected ship and buoy reports with winds of at least 34 kt for Isidore, 14-27 September, 2002.

42007 reported 46-kt winds with a gust to 60 kt at 0310 UTC 26 September. In Cuba, Isabel Rubio reported 54-kt sustained winds with a gust to 74 kt. Along the U. S. coast, the Coastal Marine Automated Network (C-MAN) Station near Burrwood, Louisiana reported 46 kt winds with a gust to 59 kt at 2300 UTC 25 September, along with a pressure of 984.7 hPa at 0900 UTC 26 September. The C-MAN station at Grand Isle reported a gust to 62 kt at 0440 UTC 26 September. Tropical storm winds were reported elsewhere along the coast from central Louisiana to the western Florida Panhandle.

Isidore caused four deaths: a rip current drowning in Louisiana, a storm surge drowning in Mississippi, a third from a tree falling on a car in eastern Mississippi, and a fourth from a car being driven into 10 ft of water in Clarksville, Tennessee. Very heavy rains caused damage in Jamaica. Isidore caused major damage to the Yucatan Peninsula and western Cuba. In the United States, the total damage due to Isidore is estimated to be $330 million, mainly in Louisiana.

Tropical Storm Josephine formed along a decaying frontal zone about 750 nmi east of Bermuda on September 17 (***Figure 1***). The tropical cyclone moved slowly north-northwestward to northward for about a day and strengthened to a minimal tropical storm very early on 18 September. Soon thereafter, Josephine accelerated northeastward in the flow ahead of a deep-layer mid-latitude trough. The system lost its tropical characteristics and merged with a larger extratropical low and frontal system on 19 September.

The **Cool Express** (PDKK) reported 37 kt winds at 0300 UTC 18 September. As Josephine became extratropical, the **Albatros** (C6LV3) reported 50-kt winds at 1200 UTC 19 September.

Hurricane Kyle had a life span of 22 days, the third longest on record for an Atlantic tropical cyclone, exceeded only by Ginger of 1971 and Inga of 1969. It developed from a non-tropical low about 715 nmi east-southeast of Bermuda on 20 September (***Figure 1***). During its long track, Kyle strengthened (or re-strengthened) to a tropical storm on four different occasions, and it became a hurricane over open water, from 25-28 September, with winds reaching 75 kt (***Figure 4***). Kyle moved erratically, but generally westward until 11 October, when the storm turned northward and northeastward and made landfall on the South Carolina and North Carolina coasts

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
25 / 0900	LATU5	33.5	55.6	030 / 40	1019.6
26 / 0600	**Prince of Waves**	25.1	58.2	230 / 36	1008.0
29 / 0000	**EWL Venezuela**	23.5	65.4	270 / 37	1011.0
30 / 1500	ELZA8	33.5	65.0	050 / 42	1017.2
02 / 0000	**Cleveland**	26.9	66.5	xxx / 35	1010.0
12 / 1200	**Titus**	37.1	74.1	090 / 35	1012.5
12 / 1200	**Texas**	39.9	68.7	090 / 41	1020.4

Table 5. Selected ship reports with winds of at least 34 kt for Hurricane Kyle, 20 September - 12 October 2002.

with winds to 40 kt. Associated tornadoes caused over $2 million dollars damage in North Carolina. Kyle merged with a cold front the next day.

While Kyle was very long-lived, for the most part it stayed away from the primary shipping lanes. The most significant ship report was from a ship with the call sign ELZA8 (name unknown), which reported 42 kt winds at 1500 UTC 30 September. Other selected observations are included in ***Table 5***. Near the coast, the C-MAN station at Diamond Shoals, North Carolina reported 41 kt sustained winds with a gust to 48 kt at 0640 UTC 12 October. Wind gusts of 35-45 kt were reported along other portions of the North and South Carolina coasts.

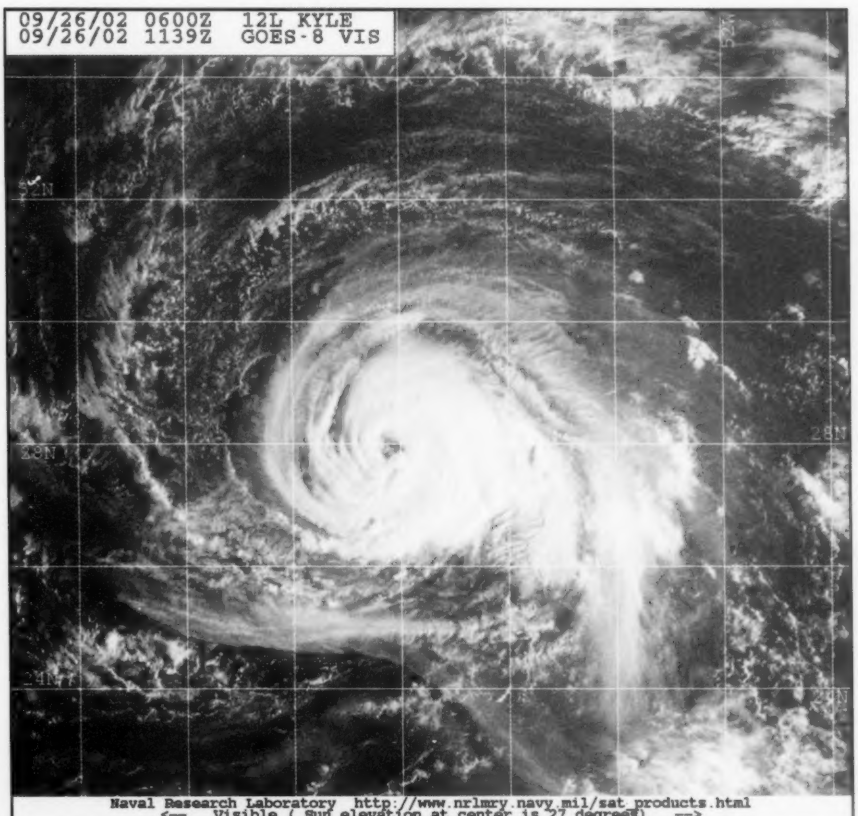

Figure 4. GOES-8 visible image of Hurricane Kyle at 1139 UTC 26 September 2002.

(Image courtesy of the Naval Research Laboratory, Monterey, CA).

Hurricane Lili's track began on 21 September, when a depression formed in the central tropical Atlantic (***Figure 1***). Lili swept across the Windward Islands on 23 September as a developing tropical storm and left four dead in St. Vincent from mud slides. After weakening back to an open wave in the central Caribbean Sea, Lili again became a tropical storm on 27 September. The storm's center took a slow jog around the north coast of Jamaica from 28-30 September and dumped heavy rains there, and to a lesser extent, over southern Haiti and eastern Cuba. Lili hit western Cuba on 1 October with winds to 90 kt.

Lili moved to the central Gulf of Mexico where winds quickly strengthened to 125 kt, Category Four intensity on the Saffir-Simpson

Hurricane Scale (***Figure 5***). But the wind speed decreased even faster than it had increased. Lili made landfall with sustained winds of 80 kt on the coast of Louisiana to the south of Intracoastal City on 3 October. Weakening over land, Lili merged with an extratropical low over the east-central United States the next day.

Lili affected several ships and buoys, with selected observations included in ***Table 6***. The most significant observation was from NOAA buoy 42001, which was just outside of the eye of Lili near the time of peak intensity. The buoy reported sustained winds of 98 kt and a gust to 130 kt at 2010 UTC 2 October, which are the strongest winds ever reported by a National Buoy Data Center buoy. The lowest reported pressure was 956.1 hPa ten minutes before the maximum winds occurred. In Cuba, Francia reported 87-kt sustained winds with a gust to 98 kt. Along the U. S. coast, an automated station run by Louisiana State University reported 63-kt sustained winds, while Intracoastal City reported a gust to 104 kt.

In addition to the four deaths in the Windward Islands, four also died in Jamaica, where flood waters swept them away. Flood damage in Jamaica was compounded by earlier heavy rain from Hurricane Isidore. There were news reports of wind damage at Cayman Brac in the northeastern Cayman Islands. Lili cut a swath of destruction across extreme western Cuba. There was a death in the province of Pinar del Rio. In Louisiana, there was a trail of wide-

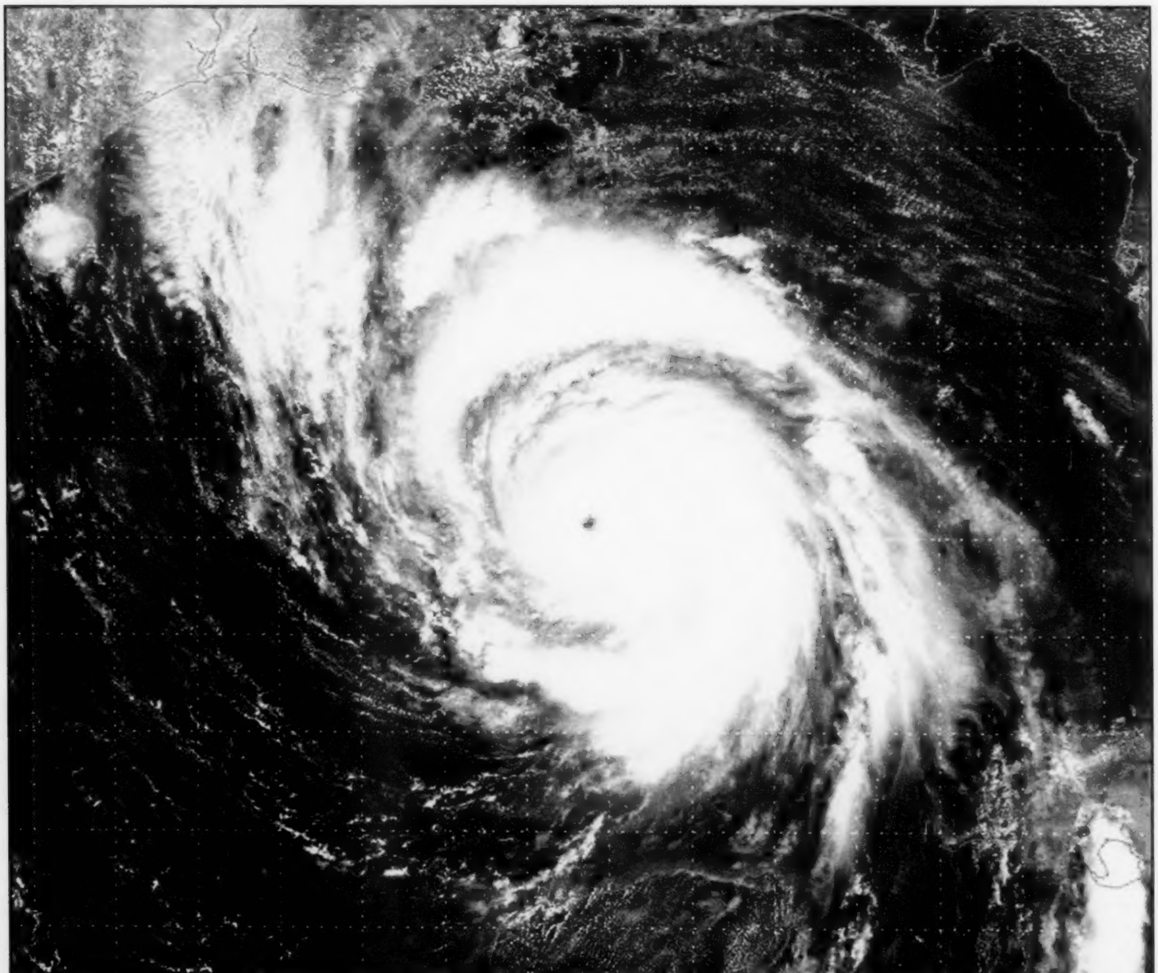

Figure 5. TERRA./MODIS visible image of Hurricane Lili at 1638 UTC 2 October 2002.
Image courtesy of NASA and the LSU Earth Scan Laboratory.

Date/Time (UTC)	*SHIP NAME* or call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
24 / 1200	**Paradise**	17.0	68.5	100 / 45	1015.0
28 / 1200	**Kota Pertama**	19.4	74.3	110 / 73	1008.7
01 / 1800	**Chemical Pioneer**	24.4	82.2	120 / 39	1012.1
02 / 0300	**Sealand Quality**	24.7	84.1	100 / 38	1010.0
02 / 0720	Buoy 42003	25.9	86.0	115 / 36G49	1009/6
02 / 1200	**Strong Virginian**	23.8	86.8	180 / 36	1005.2
02 / 1500	ELYN2	21.0	85.6	xxx / 82	1014.5
02 / 1800	**Strong Virginian**	24.7	87.8	170 / 40	1007.1
02 / 2010	Buoy 42001	25.9	89.7	xxx / 98G130	956.1
03 / 0220	Buoy 42041	27.5	90.5	095 / 56G73	986.5
03 / 0300	**Lykes Discoverer**	29.0	88.5	100 / 41	1009.2
03 / 0900	**Strong Virginian**	26.1	90.2	190 / 35	1006.0
03 / 0900	**Lykes Discoverer**	28.6	87.4	120 / 36	1009.1
03 / 1140	Buoy 42007	30.1	88.8	115 / 36G47	1008.6
03 / 1500	**Mayaguez**	28.3	93.0	300 / 37	1003.0

Table 6. Selected ship and buoy reports with winds of at least 34 kt for Hurricane Lili, 21 September - 4 October 2002.

spread wind and flood damage. The total U.S. property damage estimate is 860 million dollars.

III. Tropical Depressions

Two other tropical depressions occurred over the Atlantic during the 2002 season (***Figure. 6***). Tropical Depression Seven briefly appeared over the central Atlantic on 7-8 September. Tropical Depression Fourteen moved slowly northeastward across the northwestern Caribbean Sea from 14-16 October, spreading locally heavy rains across portions of Jamaica, Cuba, and the Cayman Islands.

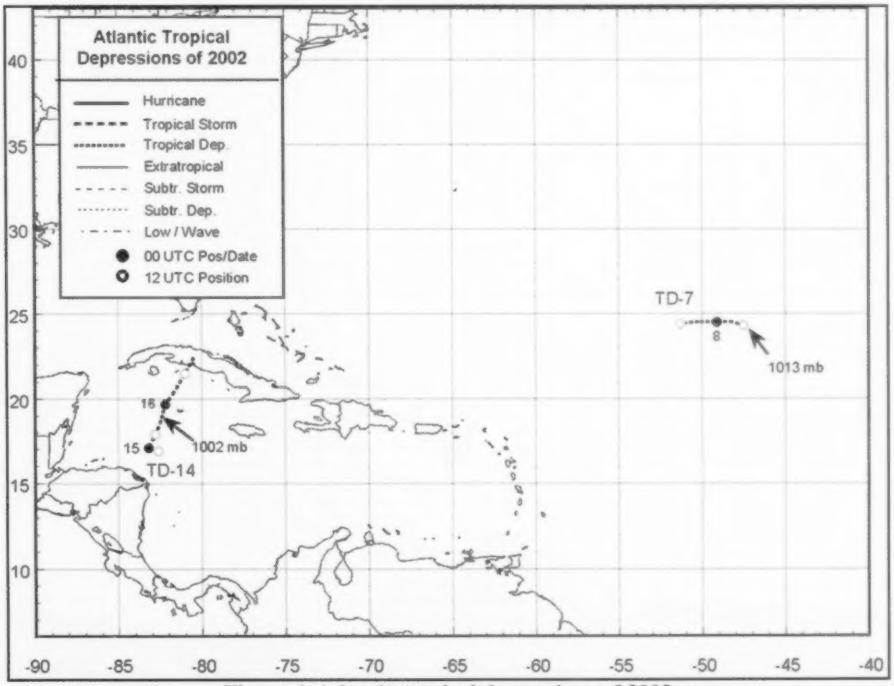

Figure 6. Atlantic tropical depressions of 2002.

Eastern North Pacific Hurricane Season of 2002

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Introduction

Tropical cyclone activity in the eastern North Pacific hurricane basin was below average in the year 2002. There were 12 cyclones of at least tropical storm strength, and 6 of these became hurricanes (***Table 1*** and ***Figure 1***). The seasonal averages are fifteen named storms and 9 hurricanes. Although the total of six hurricanes was below normal, there were five "major" hurricanes, one above the long-term average of four (a major hurricane has maximum 1-min average winds greater than 95 kt, corresponding to Category Three or higher on the Saffir-Simpson Hurricane Scale). Overall activity was fairly evenly distributed over the nominal 15 May - 30 November season, with tropical cyclones forming in each month. Kenna was the strongest hurricane of the season, with 145-kt peak winds. In addition to the 12 named tropical cyclones, there were 4 depressions that did not reach tropical storm strength.

Eastern North Pacific tropical cyclones were directly responsible for 4 deaths in 2002; these resulted from Hurricane Kenna, which made landfall north of Puerto Vallarta, Mexico near San Blas in late October. Tropical Storm Julio also made landfall in Mexico, and rains from Tropical Storm Boris caused damage even though the center of Boris remained offshore.

Individual Named Storms

Hurricane Alma originated from a tropical wave that moved across the

Name	Class*	Dates**	Max. winds (kt)	Min. pressure (mb)	Direct deaths
Alma	Hurricane	24 May - 1 June	100	960	
Boris	Tropical Storm	8 - 11 June	50	997	
Cristina	Tropical Storm	9 - 16 July	55	994	
Douglas	Hurricane	20 - 26 July	90	970	
Elida	Hurricane	23 - 30 July	140	921	
Fausto	Hurricane	21 Aug. - 3 Sep.	125	936	
Genevieve	Tropical Storm	26 Aug. - 1 Sep.	60	989	
Hernan	Hurricane	30 Aug. - 6 Sep.	140	921	
Iselle	Tropical Storm	15 - 20 Sep.	60	990	
Julio	Tropical Storm	25 - 26 Sep.	40	1000	
Kenna	Hurricane	22 - 26 Oct.	145	913	4
Lowell	Tropical Storm	22 - 31 Oct.	45[a]	1002	

Table 1. Eastern North Pacific tropical storms and hurricanes of 2002.

*Tropical Storm: wind speed of 34-63 kt. Hurricane: wind speed of 64 kt or higher.

**Dates begin at 0000 UTC and include tropical depression stage (wind speed less than 34 kt.)

[a] Lowell's peak intensity was attained west of 140° W Longitude, in the central Pacific hurricane basin.

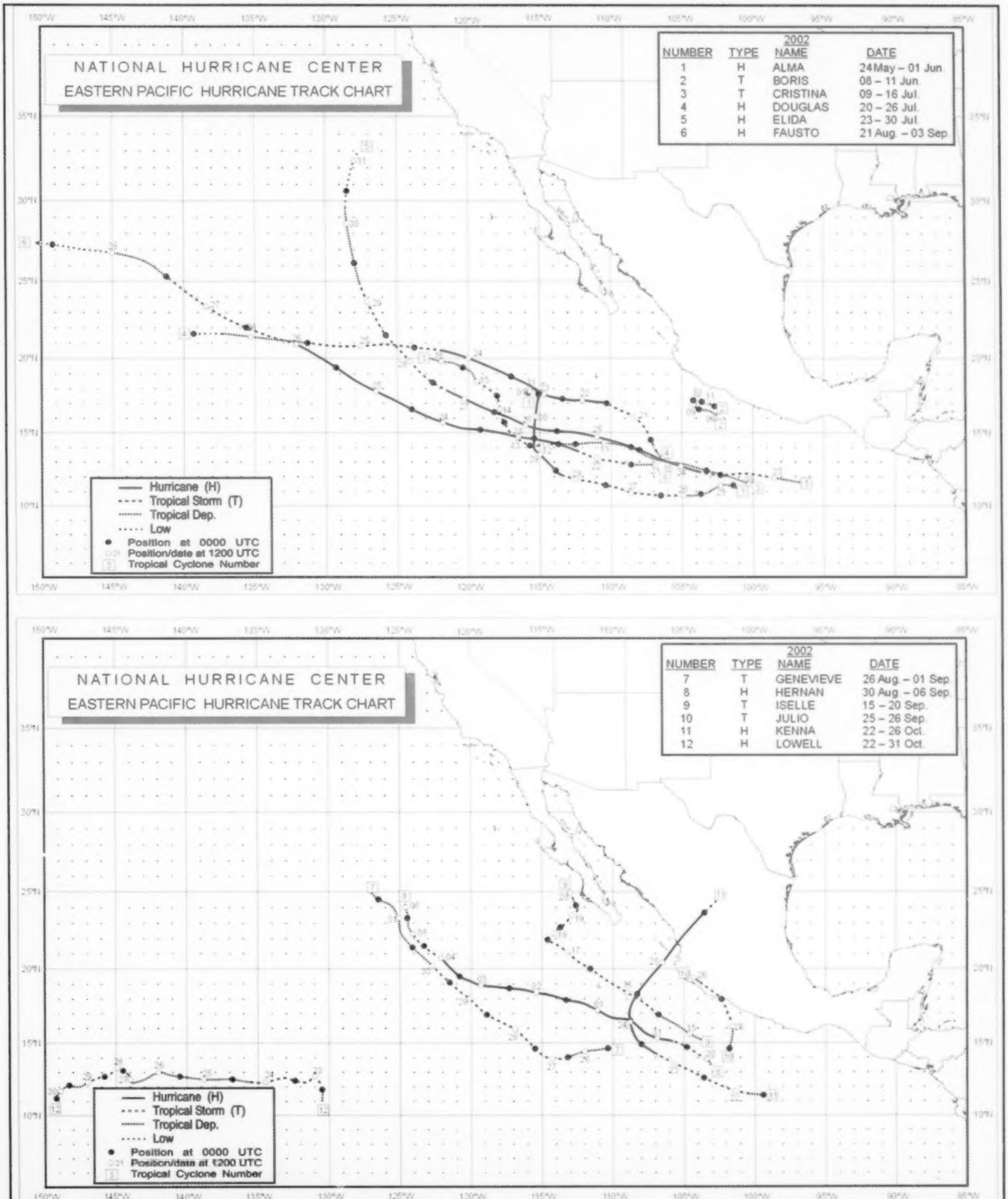


Figure 1. Eastern North Pacific tropical storms and hurricanes of 2002.

west coast of Africa on 8 May. The system developed into a tropical depression on 24 May about 485 nmi south-southeast of Manzanillo, Mexico (***Figure 1***), then moved slowly westward and strengthened into a tropical storm two days later. Alma turned west-northwestward and became a hurricane on 28 May about 680 nmi southwest of Manzanillo. Alma then began moving northwestward and northward around the western periphery of a subtropical ridge centered over Mexico.The hurricane reached its peak intensity of 100 kt on 30 May (***Figure 2***). Alma then began to weaken as it started moving over cooler water and encountered southwesterly wind shear. The cyclone weakened to a tropical storm on 31 May and stalled as its deep convection diminished. The cyclone weakened to a depression and then dissipated on 1 June about 450 nmi southwest of Cabo San Lucas, Mexico.

Tropical Storm Boris developed from the interaction of an Atlantic tropical wave with a broad and persistent eastern North Pacific disturbance southwest of Acapulco, Mexico. The system became a tropical depression on 8 June about 150 nmi west-southwest of Acapulco (***Figure 1***). The depression reached tropical storm status, as well as its peak intensity of 50 kt, on the following day. Boris moved little on 9 June and began to weaken. On 10 June, Boris drifted to the northeast and then east, and weakened back to a depression when it was located about 100 nmi south-southeast of Manzanillo. Boris degenerated to a non-convective remnant low on 11 June. The remnant low then moved southeastward and dissipated the following day. The **P&O Nedlloyd Amazon** (ELYL8) reported 39-kt winds and a 1003.8 hPa pressure at 2100 UTC 9 June. On land, the National Meteorological Service of Mexico reported storm total rains of 6.43 inches in Michoacan and 5.13 inches in Jalisco. There were media reports that several homes in unspecified locations along the Mexican coast were damaged due to heavy rains from Boris. There are no known casualties.

Tropical Storm Cristina originated from an area of disturbed weather that was first identified near Panama on 6 July. The system became a tropical depression on 9 July about 300 nmi south of Acapulco, and then moved just north of due west for three days (***Figure 1***). Despite a seemingly hostile environment, the depression strengthened to a tropical storm on 12 July. Cristina began to turn toward the north-northwest and slowly strengthened, reaching its peak intensity of 55 kt on 14 July. Shortly thereafter, Cristina weakened and turned to the west-northwest. By 16 July, Cristina had degenerated to a remnant low over colder water about 750 nmi west-southwest of Cabo San Lucas.

Hurricane Douglas first became a tropical depression about 395 nmi south of Manzanillo on 20 July (***Figure 1***). It became a tropical storm later that day. After moving generally northwestward, Douglas turned toward the west late on 21 July and strengthened into a hurricane. It

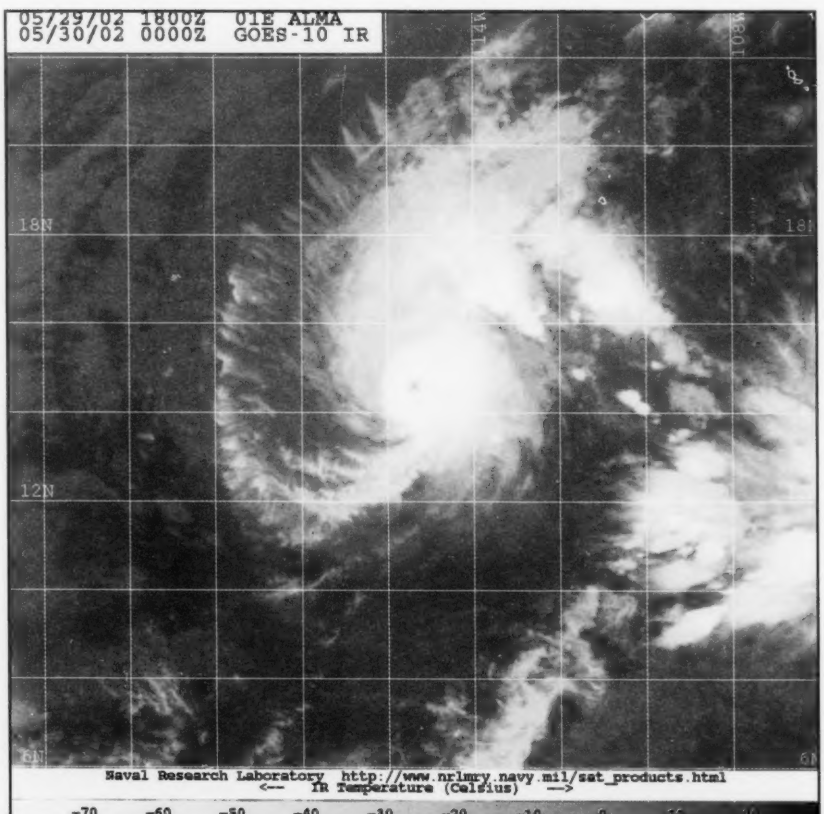


Figure 2. GOES-10 infrared image of Hurricane Alma at 0000 UTC 30 May 2002.
(Image courtesy of the Naval Research Laboratory, Monterey, CA)

reached its peak intensity of 90 kt on 22 July about 650 nmi south-southeast of Cabo San Lucas. Douglas moved west-northwestward and gradually weakened over the next two days. Douglas degenerated into a remnant low about 1000 nmi east of Hawaii on 26 July just before entering the central Pacific hurricane basin.

Hurricane Elida was the first Category five (on the Saffir-Simpson Hurricane Scale) hurricane of the season, forming from a tropical wave that moved westward across the African coast on 13 July. A tropical depression formed on 23 July about 305 nmi south-southeast of Puerto Escondido, Mexico (***Figure 1***). The cyclone strengthened very rapidly as it moved westward, becoming a tropical storm on 23 July and a hurricane less than 18 hours later. Elida turned west-northwestward on 24 July while continuing to deepen rapidly, and reached its peak intensity of 140 kt on 25 July (***Figure 3***). The hurricane moved west-northwestward for the next two days, during which time it weakened back to a tropical storm. Elida weakened to a depression on 29 July, and then became a non-convective remnant low the next day. The low dissipated late on 31 July about 465 nmi west of Los Angeles, California.

A ship with the call sign **H9LA** reported 36-kt winds and an 1008.5 hPa pressure at 0000 UTC 24 July. While high swells from Elida likely affected portions of the coast of Mexico, the high winds and heavy rains stayed well offshore, and there were no reports of damage or casualties.

Hurricane Fausto was a system which tracked from Africa nearly to Alaska. Fausto developed from a tropical wave that crossed the west-African coast on 11 August. Ten days later the system became a tropical depression about 400 nmi south-southwest of Manzanillo (***Figure 1***). The depression initially moved westward and became a tropical storm on 22 August. Fausto turned to the west-northwest and steadily strengthened, becoming a hurricane later that day

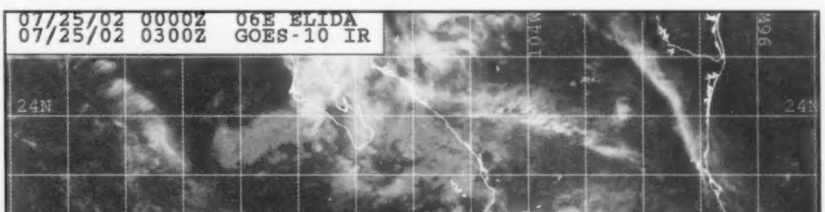


Figure 3. GOES-10 infrared image of Hurricane Elida at 0300 UTC 25 July 2002.
(Image courtesy of the Naval Research Laboratory, Monterey, CA)

about 565 nmi south-southwest of Cabo San Lucas. Additional strengthening brought Fausto to its peak intensity of 125 kt on 24 August (***Figure 4***). Weakening began the next day, and Fausto became a tropical storm again on 26 August. Fausto's large circulation was slow to spin down; winds did not fall below tropical storm strength until 28 August, shortly after Fausto crossed 140 W longitude into the central Pacific hurricane basin. Fausto became a remnant low later that day.

The low continued westward, passing about 430 nmi north of the Hawaiian Islands on 30 August. During the day the surface circulation passed underneath an upper-level low, redeveloped deep convection, and became a tropical depression again. Fausto moved to the west-northwest on 31 August, strengthened, and became a tropical storm on 1 September. The next day, Fausto turned north and accelerated ahead of a mid-latitude frontal system. Fausto was absorbed by an extratropical low early on 3 September about 600 nmi south of the Aleutian Islands.

The **Jon Lonn** (PFEW) reported 35-kt winds at 0000 UTC on 24 and 25 August.

Tropical Storm Genevieve formed from a tropical wave. It first became a depression on 26 August about 500 nmi south of Cabo San Lucas, and became a tropical storm one day later (***Figure 1***). Genevieve was approaching hurricane strength on 28 August, with maximum winds of 60 kt when it turned to the northwest and passed over cooler waters. Genevieve degenerated to a non-convective remnant low about 960 nmi west-northwest of Cabo San Lucas on 1 September.

Hurricane Hernan, the second of the season's three Category 5 (on the Saffir-Simpson Hurricane Scale) hurricanes, appears to have developed from a weak tropical wave that crossed the African coast on 16 August. The system developed into a

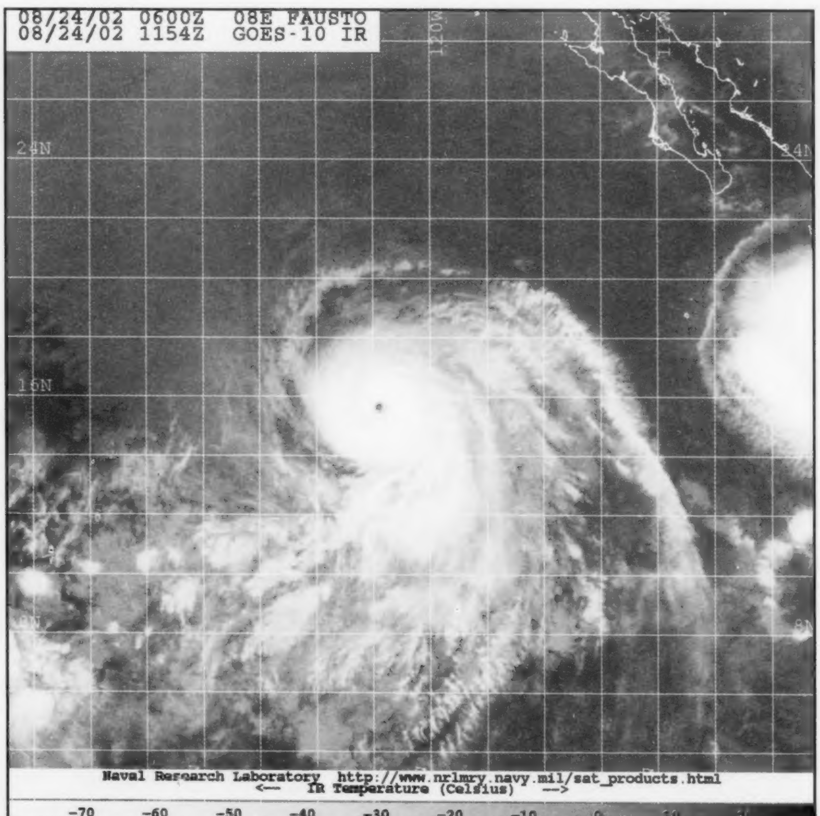


Figure 4. GPES-10 infrared image of Hurricane Fausto at 1154 UTC 24 August 2002.

(Image courtesy of the Naval Research Laboratory, Monterey, CA)

tropical depression on 30 August about 340 nmi south-southeast of Manzanillo (***Figure 1***). Moving west-northwestward for five days and northwestward thereafter, Hernan had an uncomplicated life cycle. After genesis, the cyclone strengthened steadily, with maximum winds reaching 140 kt on 1 September, an increase of 110 kt in 54 hours (***Figure 5***). This was followed by steady decay. By 6 September Hernan degenerated to a remnant low about 780 nmi west of Cabo San Lucas. The remnant low drifted southwestward until it dissipated on 9 September.

The **Eemsgracht** (PDXQ) reported 37-kt winds at 0300 UTC 31 August, while the **Zim Europa** (4XFN) reported 36-kt winds three hours later. The center of Hernan passed about 90 nmi south of Socorro Island on 1 September while near peak intensity. No reports were received from the island regarding conditions experienced there.

Tropical Storm Iselle formed from a tropical wave that crossed the west coast of Africa on 31 August. On 15 September the system became a tropical depression about 270 nmi south of Manzanillo (***Figure 1***). The depression moved west-northwestward and strengthened into a tropical storm on 16 September. Iselle moved northwestward for the next 3 days and gradually strengthened, eventually reaching a peak intensity of 60 kt late on 17 September. Shortly thereafter, the storm made a sharp turn to the northeast. Vertical wind shear increased, and Iselle rapidly weakened, becoming a tropical depression on 19 September while located about 80 nmi southwest of Puerto Cortes, Mexico. Iselle degenerated into a non-convective low early on 20 September, and the circulation dissipated later that day.

There were no ship reports of tropical storm winds from Iselle that were considered reliable. On land, Manzanillo reported a 40-kt sustained wind at 2300 UTC 15 September. Iselle briefly produced locally heavy rainfall across the southern third of the Baja California peninsula on 19 September, but rainfall totals appeared to be generally less than 2 inches. There were no reports of damage or casualties.

Tropical Storm Julio, the first of two landfalling tropical cyclones in 2002, formed from a persistent area of monsoon-like disturbed weather near the west coast of Mexico. The system gradually organized and developed into a tropical depression on 25 September about 175 nmi southwest of Acapulco (***Figure 1***). The depression moved northward and strengthened into a tropical storm later that day, then reached a peak intensity of 40 kt prior to landfall on the Mexican coast just west-northwest of Lazaro Cardenas early on 26 September. A subsequent northwestward motion took the center over the mountains of southwestern Mexico, where the system dissipated north of Manzanillo.

There were no ship reports of tropical storm force winds from Julio. On the coast, Zihuatanejo, Mexico reported a

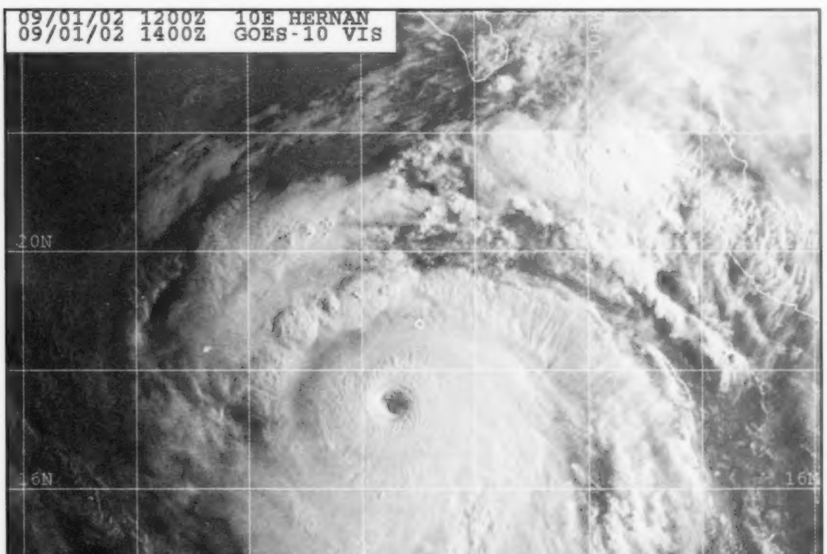


Figure 5. GOES-10 visible image of Hurricane Hernan at 1400 UTC 1 September 2002.

(Image courtesy of the Naval Research Laboratory, Monterey, CA).

sustained wind of 35 kt with a gust to 45 kt at 2042 UTC 25 September. Julio caused locally heavy rains and gusty winds over portions of the southern coast of Mexico, and there were media reports of damage to homes from flash floods. There were no reports of casualties.

Hurricane Kenna, the last and strongest of the eastern North Pacific hurricanes of 2002, developed from a disturbance that moved westward across Central America and entered the eastern North Pacific basin on 19 October (***Figure 1***). The system became a tropical depression on 22 October about 325 nmi south of Acapulco, moved westward, and quickly reached tropical storm strength. Kenna became a hurricane about 400 nmi south of Cabo Corrientes, Mexico, late on 23 October. Kenna continued to strengthen on 24 October, with its heading turning to the northwest and then north late in the day and its forward speed slowing. Late that day, roughly 24 hours after reaching hurricane strength, reports from a reconnaissance aircraft indicated that Kenna's winds had reached 140 kt, and its minimum pressure had fallen to 917 hPa (***Figure 6***).

The flow ahead of a large mid- to upper-level trough west of Baja California turned Kenna to the northeast beginning late on 24 October. As Kenna accelerated toward the coast of Mexico, the cyclone intensified slightly, and early the next day reached its peak intensity of 145 kt. At this time Kenna was only about 125 nmi west-southwest of Cabo Corrientes. Kenna continued to accelerate, and while still over warm waters it began to weaken under increasing shear. Kenna's convective activity increased in the hours just prior to landfall, and a reconnaissance aircraft reported extremely severe turbulence that was among the most intense ever experienced by the flight crew. The hurricane made landfall near San Blas, Mexico with winds near 120 kt at 1630 UTC 25 October. Kenna continued northeastward and weakened very rapidly over the mountains of Mexico; by early on 26 October it was a minimal tropical storm, and the closed surface circulation dissipated a few hours later. The remnants of Kenna moved into the northwestern Gulf of Mexico later that day, which enhanced rainfall in the southeastern United States.

There were no ship reports of tropical storm or hurricane winds from Kenna. Few observations were available from the landfall area as well. At Tepic, in the state of Nayarit (located about 15 nmi inland) the highest measured sustained wind was 76 kt, with a storm total rainfall of 3.35 inches. Rainfalls of 4-10 inches occurred elsewhere across portions of the states of Colim and Nayarit. The Meteorological Service of Mexico estimates that the storm surge in San Blas was as high as 16 ft. Storm surge also affected Puerto Vallarta, but no measurements are available. There were reports of 10-ft waves rushing inland from the bay.

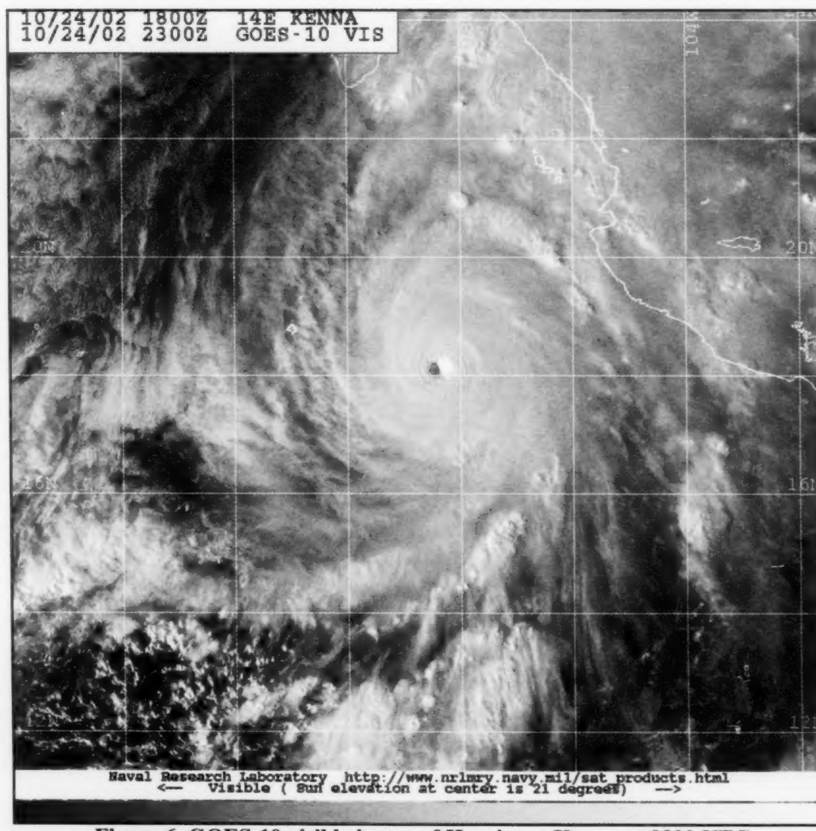


Figure 6. GOES-10 visible image of Hurricane Kenna at 2300 UTC 24 October 2002.

(Image courtesy of the Naval Research Laboratory, Monterey, CA.)

Mexican authorities report four deaths from Kenna. There were media reports of over 100 injuries in San Blas and Puerto Vallarta from flying glass and other debris. All but roughly 200 of the 9000 residents of San Blas evacuated, likely accounting for the relatively low number of casualties. In Puerto Vallarta, the estimated $5 million of damage was attributed mainly to storm surge. There are no monetary estimates of damage in San Blas. However, media reports indicated that 80 to 90% of the homes were damaged or destroyed, and large commercial shrimp boats were dragged up to 300 yards from their docks.

Kenna is the third strongest hurricane of record to have struck the west coast of Mexico. Only an unnamed hurricane in 1959 and Madeline in 1976 are known to have been stronger at the time of landfall.

Tropical Storm Lowell originated from a westward-moving disturbance that entered the eastern North Pacific basin on 12 October. On 22 October the system became a tropical depression about 1380 nmi southwest of Cabo San Lucas (***Figure 1***). After briefly drifting north, the depression moved westward and strengthened to a 40-kt tropical storm the following day. Southwesterly vertical wind shear caused Lowell to weaken back to a depression on 24 October. Lowell crossed 140 W longitude into the central Pacific hurricane basin on 26 October. On 27 October as the vertical wind shear lessened, Lowell regained tropical storm strength. Lowell reached its peak intensity of 45 kt on 28 October about 700 nmi east-southeast of the Hawaiian Islands. Lowell then turned to the west-southwest and began to weaken, becoming a tropical depression again on 29 October, and dissipating two days later.

Tropical Depressions

Four other tropical depressions occurred in the eastern North Pacific during 2002 (***Figure 7***). Tropical Depression Three-E existed from 27-29 June far away from land. Tropical Depression Seven-E was tracked from 6-8 August, also well away from land. The last cyclone of the season, Tropical Depression Sixteen-E, existed from 14-16 November well south and southwest of Cabo San Lucas.

The other cyclone, Tropical Depression Eleven-E, formed on 5 September about 120 nmi southwest of Cabo Corrientes. Watches and warnings were posted along portions of the Mexican coast in anticipation of strengthening that didn't occur. The system weakened to a remnant low on 8 September and dissipated just west of southern Baja California two days later. ⚓

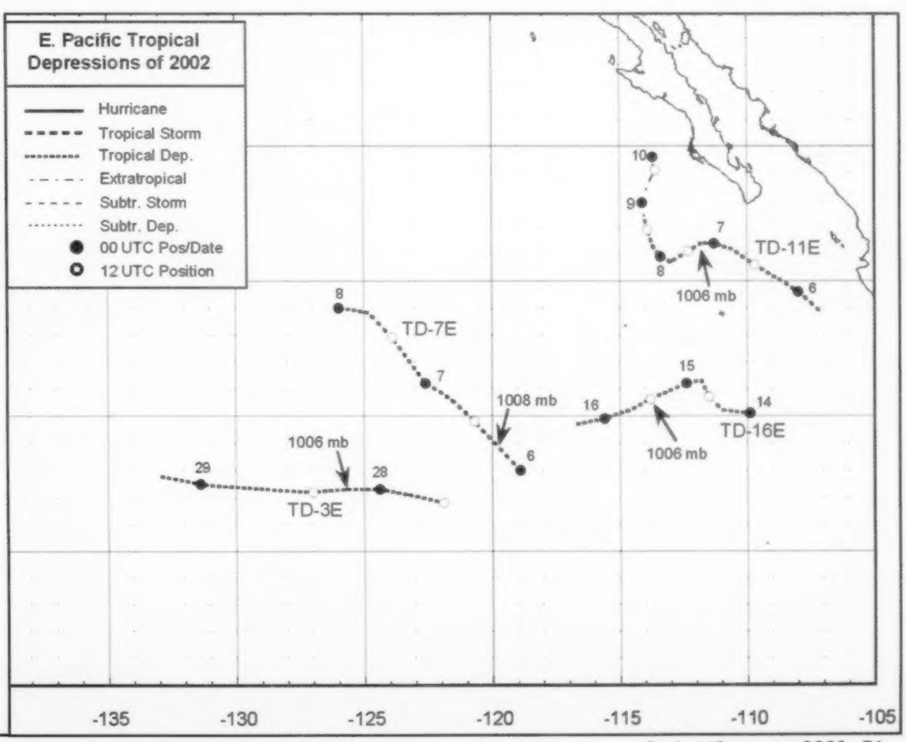


Figure 7. Eastern North Pacific Tropical Depressions of 2002.

Mean Circulation Highlights and Climate Anomalies September 2002 through February 2003

A. James Wagner
Senior Forecaster, Climate Operations Branch
Climate Prediction Center /NCEP/NWS/NOAA

September - October 2002

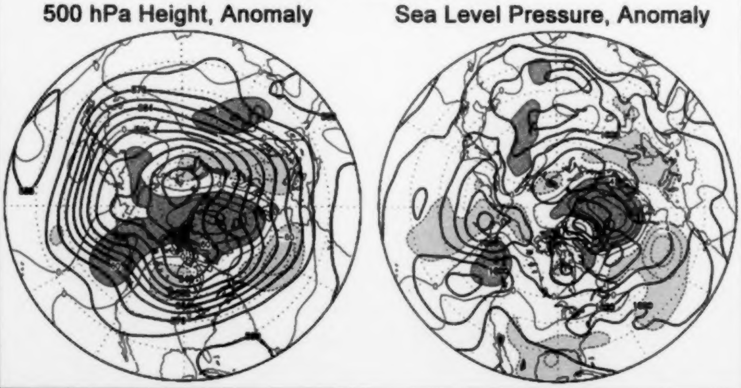
The mean mid-tropospheric circulation during the early fall months was characterized by above-normal heights over most of the Arctic Basin, with lobes extending into the northern Gulf of Alaska and the North Atlantic over eastern Greenland and Iceland. Below-normal heights prevailed at middle latitudes over most of the Northern Hemisphere, with troughs located over the western and central Pacific, central North America, eastern Atlantic, and southeastern Europe and the Ukraine. The two-month average map does not adequately reflect the somewhat different patterns that prevailed before and after the circulation changed quite abruptly in the first half of October. Above normal heights were associated with a continuation of summer warmth over eastern and northern Europe and the eastern U.S. during September and the first week of October, but the area of blocking retrograded from Europe to Iceland and eventually Greenland during October, while troughs deepened over the central U.S. and the central Atlantic. This dramatic change, which was reflected in a near-record low value of North Atlantic Oscillation (NAO) Index, occurred at the same time that the nights became noticeably longer than the days, resulted in dramatic changes in the temperature over both the U.S. and Europe. The normal seasonal cooling trends were accentuated by the rapid replacement of well above normal temperatures by significantly below normal values within a period of just a few weeks.

El Nino continued to develop over the Pacific Ocean, and tropical precipitation patterns over the Pacific were typical for this phase of the phenomenon, being abnormally dry over much of Indonesia and Australia and wetter than normal near the date line. Its influence was also becoming evident on the circulation over both the Pacific and Atlantic oceans away from the tropics in the form of stronger than normal subtropical westerlies.

Although sea surface temperatures were above normal over much of the subtropical Atlantic, Caribbean and Gulf of Mexico and the number (12) of named tropical storms developing was two more than normal, the number (4) reaching hurricane intensity was two fewer than normal, and only two of these reached major hurricane status (Category 3 or stronger). Stronger than normal subtropical westerlies tended to shear apart or at least weaken most of the storms before they became very intense. Nevertheless, the eight named tropical systems that formed during September was a record for any calendar month, making up for the fact that the first storm of the season reaching hurricane intensity did not occur until Sept. 11, the latest date for this since 1941. Two of the hurricanes, Isidore and Lili, made landfall along the Gulf coast of the U.S. Their size, intensity, and relatively slow motion contributed to the extensive area of below normal sea level pressure over the southern U.S. and the Gulf of Mexico shown on the map. Moisture brought into the U.S. mainland from these and other storms began to provide welcome relief from the long multi-season drought in many areas of the South and Southeast.

September–October 2002

500 hPa Height, Anomaly — Sea Level Pressure, Anomaly



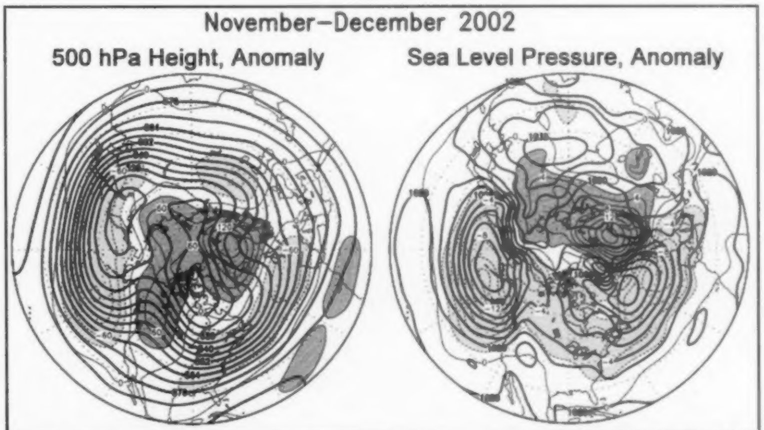
The chart on the left shows the seasonal mean sea level pressure at four hPa intervals in heavy solid lines, labeled in hPa. Anomalies of Sea Level Pressure (SLP) are contoured in dashed lines and labeled at two hPa intervals, with heavy shading and light solid lines in areas greater than two hPa above normal, and light shading and light dashed lines in areas more than two hPa below normal.

November - December 2002

The mean circulation over the Northern Hemisphere during the last two months of 2002 could be described simply as having stronger than normal westerlies south of normal over most of the hemisphere, with widespread blocking at high latitudes. The entire Arctic Basin, North Atlantic, and northwestern Canada had well above normal mid-tropospheric heights, but sea level pressure was above normal at high latitudes, mostly only on the Eurasian side of the Hemisphere. Scandinavia and parts of northern Europe were especially cold and drier than normal. Storms tracked well south of normal all the way across the Atlantic, and continued on into the Mediterranean Sea instead of turning northeastward towards Iceland and northen Europe, as is the norm for the majority of them usually do. The strong negative anomaly centers on both the 500-mb height and the sea level pressure maps just west of the Bay of Biscay were associated with recurrent intense storms, one of which split and eventually sank a large oil tanker early in November.

Below-normal heights and sea level pressure dominated the entire Pacific Basin at middle latitudes, a pattern often observed with El Niño. The strong ridge over northwestern Canada deflected many of the Pacific storms northward toward Alaska, which experienced the beginning of an unusually mild winter. At the same time, this ridge, along with the broad trough across the Atlantic, served to deflect cold air southward from the Canadian Arctic into the eastern part of the United States, which began to experience the first of several consecutive noticeably colder than normal months.

El Niño continued over the equatorial Pacific, and the southward displaced Aleutian Low and strong westerlies and associated active storms were typical atmospheric responses during the cold season that have accompanied El Niño events in the past. However, the ridge over western North America tended to block or deflect many of the storms before they reached California, resulting in less rainfall in the Southwest than had accompanied most past El Niños. Although the cold air from Canada contributed to an early onset to the winter snow season over the central and eastern U.S., it tended to allow less moisture into the U.S., and some parts of the Great Plains and Midwest experienced record and near-record dryness.



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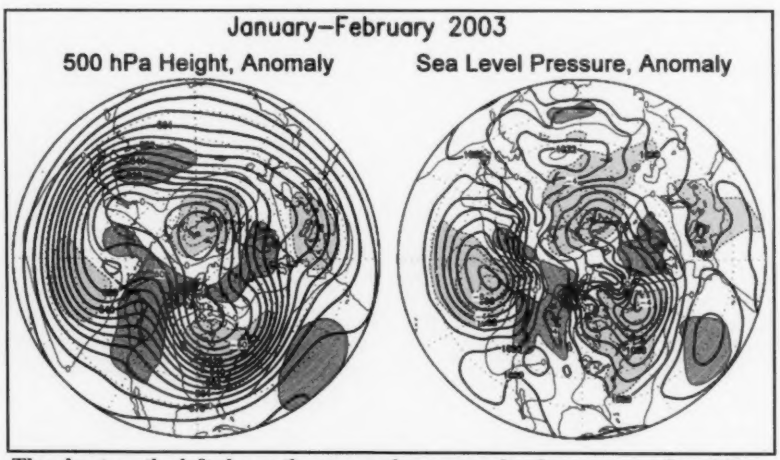
January - February 2003

Many of the large-scale average features of the circulation during the two mid-winter months did not change much from the previous two months. Stronger than normal westerlies continued across middle latitudes of both the Pacific and the Atlantic, although the Bermuda-Azores ridge strengthened somewhat during the first two months of 2003. Blocking continued over the northeastern Atlantic and northern Europe, although it was not as strong as during the previous period. The ridge near the west coast of North America strengthened, and the broad trough over the Atlantic became somewhat more localized over the western part of the ocean. Above average storminess continued over the Mediterranean Sea.

The average circulation for this two-month period showed a weakening of the North Atlantic and Arctic Oscillation (NAO and AO) patterns, although they were still in a negative phase most of the time. Although El Niño began to noticeably weaken, especially over the eastern equatorial Pacific, the positive phase of the Pacific-North American pattern (PNA) which has been associated with many past El Niño events became more prominent, especially during January, resulting in record high temperatures in much of the West late in the month, while at the same time the eastern U.S. was cold and dry with repeated outbreaks of Arctic air. Unusually mild weather continued in Alaska, resulting in one of the mildest winters on record in that state. The strong ridge along the West Coast also prevented most Pacific storms from approaching the California coast until the middle of February, resulting in an unusually long dry period there, where El Niño winters are characteristically wetter than normal. However, when the ridge weakened in the middle of February, Pacific storms again began to bring heavy rains to California and move inland. One of these systems redeveloped over the central and eastern U.S. and brought record and near-record amounts of snow and sleet to the Northeast as it moved slowly eastward to the south of a massive Arctic High over southeastern Canada. The upper level disturbance associated with this storm could be traced all the way across the Atlantic and the Mediterranean, where it again interacted with abnormally cold air and produced an unusual heavy snowfall in parts of Israel and adjacent countries in the Mideast.

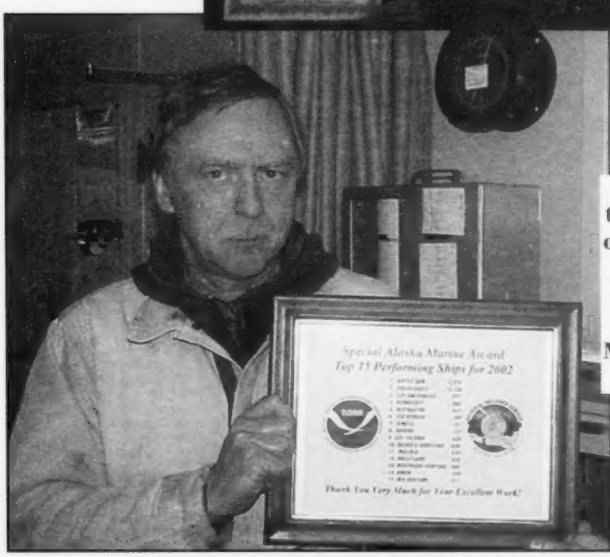


The chart on the left shows the seasonal mean sea level pressure at four hPa intervals in heavy solid lines, labeled in hPa. Anomalies of Sea Level Pressure (SLP) are contoured in dashed lines and labeled at two hPa intervals, with heavy shading and light solid lines in areas greater than two hPa above normal, and light shading and light dashed lines in areas more than two hPa below normal.

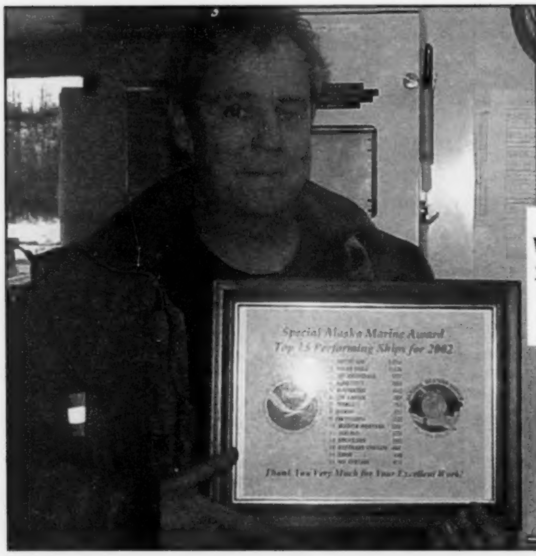
Alaska Region Recognition

For the 2nd year in a row, the *Arctic Sun* has won the Alaska Ship Observation Reporting Championship! The *Arctic Sun* took an Alaska Record 1,216 weather observations in 2002, which was an improvement of 39.5% over their winning total from 2001. This vessel is a Liquified Natural Gas Tanker which makes 18 round trips per year between Nikiski, Alaska and Tokyo, Japan. Pictured left to right: 2nd Officer Dominico Scano, Captain Pasquale Mattera, 2nd Officer Franco Di Cristo, and 1st Officer Gioacchino Masiello. They received their award while in port at Nikiski, Alaska on February 28, 2003.

Pictured left to right: 3rd Mate Brian Bassett along with Captain Jeff Dyer of the *CSX Tacoma* received an Outstanding Performance Award while at the Port of Anchorage on January 14, 2003. The *CSX Tacoma* is a National VOS Award winning boat for 2002; they had their best year ever for transmitting ship observations. They took 44% more observations in 2002 than in 2001, with a total of 638.

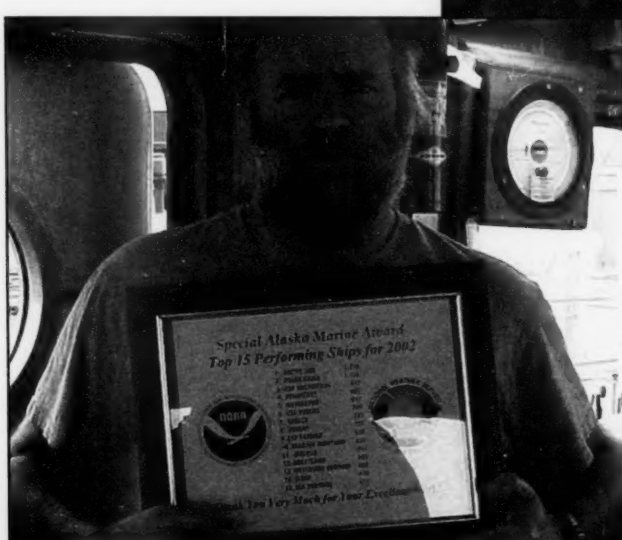


The *CSX Anchorage* finished 3rd in the Alaska rankings for 2002 with an outstanding total of 977 observations. This is a 34% increase over 2001. Pictured here is 3rd Mate Fred Koster receiving a Special Alaska Marine Award on February 4th while in the Port of Anchorage.



2nd Mate Mike Vanderhorst of the *Westward Venture* received a Special Alaska Marine Award for 2002 while in the Port of Anchorage on February 4, 2003. The *Westward Venture* had an excellent year with 460 weather observations.

Pictured left to right is Anchorage Port Meteorological Officer Larry Hubble presenting a Special Award to 3rd Mate Steve Sottak of the *Northern Lights* while in the Port of Anchorage Alaska on January 7, 2003. The crew of the *Northern Lights* took 319 weather observations in 2002, which resulted in a significant increase over previous years.



Chief Mate Mark Irish of the *Tug Malolo* received a Special Alaska Marine Award while in the Port of Anchorage on February 10, 2003. The *Malolo* took 544 observations in Alaska waters in 2002, which was a 12% increase over 2001.

Captain Larry Ohnemus (on the left) and Chief Mate Steve Illige (on the right) of the *Crowley Tug Navigator* received a Special Alaska Marine Award while in the Port of Anchorage on February 24, 2003. The *Navigator* is one of Alaska's Most Improved VOS Boats for 2002 and finished the year in 5th place in the Alaska Rankings. They increased their weather observation count by 510% in 2002 by going from 166 observations in 2001 to 847 observations in 2002.

Chief Mate Steve Illige aboard the *Crowley Tug Navigator* received an Outstanding Performance Award while in the Port of Anchorage on January 21st.

Pictured left to right is 1st Officer Kirk M. Piper and Tote Cargo Supervisor Dale Westerlin from the *Greatland*, receiving a Special Alaska Marine Award for 2002 while in the Port of Anchorage on February 9, 2003. The *Greatland* had 503 observations for 2002 and recently was named the Alaska Ship of the Month for January 2003 with 131 observations.

National Weather Service VOS Program New Recruits From November 1, 2002 to April 30, 2003

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
AEROGRAPHER	KL0YL	AEROGRAPHER C/O NWS	KODIAK, AK
ALKIN KALKAVAN	TCQP	TURKON	NORFOLK, VA
AMERICAN TERN	WAHF	OSPRY SHIP MGMT, INC.	JACKSONVILLE, FL
CAMAI	WCY2272	CAMAI C/O NWS	KODIAK, AK
CAPE LAMBERT	KJCJ	AMERICAN OVERSEAS MARINE INC.	BALTIMORE, MD
CAPE VICTORY	KAEY	MILITARY SEALIFT COMMAND	HOUSTON, TX
CAPE VINCENT	KAES	MILITARY SEALIFT COMMAND	HOUSTON, TX
CARNIVAL CONQUEST	3FPQ9	CARNIVAL CRUISE LINES	NEW ORLEANS, LA
CLEMENTINE MAERSK	OUQK2	MAERSK PACIFIC LTD.	SEATTLE, WA
COLUMBINE MAERSK	OUHC2	MAERSK PACIFIC, LTD.	SEATTLE, WA
CORNELIA MAERSK	OWWS2	MAERSK PACIFIC LTD.	SEATTLE, WA
ENERGY ENTERPRISE	WBFJ	NEW ENGLAND POWER	BALTIMORE, MD
ERNEST CAMPBELL	WBD3005	ERNEST CAMPBELL	KODIAK, AK
EVER URANUS	3FCA9	EVERGREEN AMERICA CORP.	SEATTLE, WA
HATSU ELITE	VSTG7	EVERGREEN AMERICA CORP.	SEATTLE, WA
HATSU ETHIC	VQFS4	EVERGREEN AMERICA CORP.	SEATTLE, WA
INDUSTRIAL CRESCENT	V2UD	GENSTEAM CORP. LTD.	NORFOLK, VA
KILO MOANA	WDA7827	UNIVERSITY OF HAWAII	JACKSONVILLE, FL
LEYLA KALKAVAN	TCCJ7	TURKON AMERICA, INC.	NORFOLK, VA
LT URBAN	3FXN9	EVERGREEN AMERICA GROUP	SEATTLE, WA
LYKES RANGER	ZIYE7	STRACHAN SHIPPING	HOUSTON, TX
MARGARITA	OXQZ2	CAROLS SALDIS	MIAMI, FL
MCKEE SONS	WCZ9703	GRAND RIVER NAVIGATION	CHICAGO, IL
MIDNIGHT SUN	WAHG	TOTEM OCEAN TRAILER EXPRESS	SEATTLE, WA
NOAA SHIP NANCY FOSTER	WTER	NOAA SHIP NANCY FOSTER	NORFOLK, VA
ORKUN KALKAVAN	TCCG6	TURKON AMERICA INC.	NORFOLK, VA
PACIFIC EXPLORER	V7DN3	BIEHL & CO.	HOUSTON, TX
PEQUOD	ELVK8	INTERNATIONAL SHIPPING SERVICES	HOUSTON, TX
PRESQUE ISLE	WZE4928	USS GREAT LAKES FLEET	CHICAGO, IL
RESOLUTION	WBR6941	DEPT. OF FISH & GAME	KODIAK, AK
SAUDI TABUK	HZZD	BIEHL	HOUSTON, TX
SEABULK ARCTIC	WCY7054	SEABULK ARCTIC - ALASKA MARITIME AGENCY	KODIAK, AK
STAR ISTIND	LAMP5	STRACHAN SHIPPING COMPANY	HOUSTON, TX
STIMSON	WCY2270	STIMSON, FISH & WILDLIFE PROTECTION	KODIAK, AK
STRONG AMERICAN	WCX6083	JORE INTERNATIONAL	HOUSTON, TX
TURKON AMERICA	V7CS3	TURKON AMERICA , INC.	NORFOLK, VA
UBC SAIKI	P3GY9	ATHENA MARINE CO., LTD./ INTERSHIP HOUSE	SEATTLE, WA
USCGC CYPRESS	NCPI	COMMANDING OFFICER	NEW ORLEANS, LA
USCGC MUSTANG	NJSH	USCGC MUSTANG WPB1310	KODIAK, AK
USNS SHUGART	NAOQ0	USNS SHUGART (2ND OFCR)	BALTIMORE, MD
WESTWOOD COLUMBIA	C6SI4	OCEAN AGENCIES, SUITE 202	SEATTLE, WA
WOLDSTAD	WCY2271	WOLDSTAD C/O NWS	KODIAK, AK

-- Welcome Aboard and Thanks! -- Luke

2002 VOS Outstanding Performers

It was another banner year for the VOS program. Over 250,000 observations were submitted during 2002, exceeding last year's count by over 63,000. The 16 Port Meteorological Officers (PMO) got together and nominated the following vessels as outstanding performers for the VOS program:

Albemarle Island
APL Japan
APL Korea
Arctic Sun
Atlantic Cartier
Bernado Quintana A
Blarney
Carnival Triumph
Cason J. Calloway
Charles Island
Chesapeake Bay
Cornelious Maersk
Courtney L
CSX Anchorage
CSX Enterprise
CSX Hawaii
CSX Innovator
CSX Kodiak
CSX Navigator
CSX Pacific
CSC Producer
CSC Reliance
CSC Spirit
CSX Tacoma
Delaware Bay
El Yunque
Endeavor
Fidelio
Great Land
Inspiration
Kapitan Maslov
Kennicot
Liberty Star
Lihue
Lykes Discoverer
Lykes Explorer
M/V Edgar B. Speer
M/V Indiana Harbor
M/V James R. Barker
M/V Joseph L. Block
Mahimahi
Malolo
Marit Maersk
Melville
Mesabi Miner
Mokihana
Natoma
Navigator
NOAA Ship Albatross IV
NOAA Ship Delaware II
NOAA Ship Gordon Gunter
NOAA Ship Oregon II
Overseas Joyce
Overseas New Orleans
Pacific Pride
Paragon
Polar Eagle
President Adams
President Grant
President Kennedy
President Truman
R/V Ewing
Rebecca Lynn
Saudi Hofuf
Sea Venture
Seabulk Montana
Sealand Commitment
Sealand Explorer
Sealand Integrity
Sealand Motivator
Seneca
Sidney Foss
Sinuk
Southdown Challenger
Star Eagle
Star Florida
Strong Patriot
Tellus
Westwood Breeze
Westwood Marianne

Thanks and Way to Go!! -- Luke

VOS Program Awards

Seattle PMO Pat Brandow presented a 2001 VOS plaque to the *Westwood Anette* for high quality of surface marine observations. Standing left to right are: 2nd officer Florito Rodreguez, Capt Joselito Monreal, and Chief Officer Edgardo Cimarra.

PMO Jim Saunders presents a VOS Award to Radio Officer Richard W. Brandfas of the *M/V Green Lake*.

PMO Jim Saunders presents a VOS Outstanding Performance Award to Capt Craig Langford and 2nd Officer Frank Lang of the *M/V Fidelio*.

3rd Officer Lazaro V. Herrfra and Capt Roger Murch of the *M/V Frances L* received a National VOS award.

Pictured left to right is 2nd Mate Mark Irish, Chief Mate George Nielsen, and Captain Jon Larson of the *Tug Malolo* of Dunlap Towing which recieved a VOS Award. The crew reports a large percentage of the Gulf of Alaska weather observations. The *Tug Malolo* steams primarily in the waters from Valdez to Kodiak and Cook Inlet to Chignik, pulling a fuel barge.

Seattle PMO Pat Brandow presented a 2000 VOS award to the *Elliot Bay* for superior performance. Pictured left to right are: 2nd Mate Feliciano Micabalo, Master, Capt. Ruben Redosendo, and 3rd Mate Pepe Calvo.

Captain P. Bakshi of the *M/V Maersk Wind* was presented with a VOS award by PMO Jim Saunders.

PMO Jim Saunders (pictured center) presents a VOS Outstanding Performance Award to Chief Officer A.J. Lowry (on the left) and Capt Bagley (on the right) of the *M/V Tellus.*

VOS Cooperative Ship Report January 1 to April 30, 2003

The values under the monthly colums represent the number of weather reports received at NCDC. The current month plus the previous 3-4 month's numbers reflect real-time observations plus the delayed mode observations as they are received and entered.

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1ST LT JACK LUMMUS	WJLV	NYC	3	0	0	0	0	0	0	0	0	0	0	0	3
2ND LT. JOHN P. BOBO	WJKH	Norfolk	57	12	46	64	0	0	0	0	0	0	0	0	179
A.P. MOLLER	OVYQ2	Seattle	0	31	20	0	0	0	0	0	0	0	0	0	51
ADVANTAGE	WPPO	Norfolk	9	7	16	0	0	0	0	0	0	0	0	0	32
AGNES FOSS	WYZ3112	Kodiak	5	1	4	17	0	0	0	0	0	0	0	0	27
AGRIUM	WAB930	Anchorage	53	29	38	48	0	0	0	0	0	0	0	0	168
ALASKA MARINER	WSM5364	Anchorage	0	3	0	0	0	0	0	0	0	0	0	0	3
ALBEMARLE ISLAND	C6LU3	NYC	69	70	61	60	0	0	0	0	0	0	0	0	260
ALLIGATOR STRENGTH	3FAK5	Oakland	8	0	0	0	0	0	0	0	0	0	0	0	8
ALPHA HELIX	WSD7078	Kodiak	0	0	7	9	0	0	0	0	0	0	0	0	16
ALTAIR VOYAGER	C6OK	Baltimore	0	14	14	9	0	0	0	0	0	0	0	0	37
AMERICA STAR	GZKA	Houston	106	62	1	0	0	0	0	0	0	0	0	0	169
ANASTASIS	9HOZ	Miami	18	30	0	0	0	0	0	0	0	0	0	0	48
ANKERGRACHT	PCQL	Baltimore	34	29	47	9	0	0	0	0	0	0	0	0	119
APL JADE	9VVD	Norfolk	8	4	0	0	0	0	0	0	0	0	0	0	12
APL CHINA	S6TA	Seattle	4	60	58	0	0	0	0	0	0	0	0	0	122
APL CHINA	WDB3161	Seattle	0	0	0	29	0	0	0	0	0	0	0	0	29
APL GARNET	9VVN	Oakland	32	30	20	0	0	0	0	0	0	0	0	0	82
APL JAPAN	S6TS	Seattle	38	43	54	68	0	0	0	0	0	0	0	0	203
APL KOREA	WCX8883	Seattle	31	43	46	37	0	0	0	0	0	0	0	0	157
APL PHILIPPINES	WCX8884	Seattle	28	32	29	26	0	0	0	0	0	0	0	0	115
APL SINGAPORE	WCX8812	Seattle	57	62	64	69	0	0	0	0	0	0	0	0	252
APL THAILAND	WCX8882	Seattle	62	47	60	21	0	0	0	0	0	0	0	0	190
APL TURQUOISE	9VVY	Oakland	42	37	49	43	0	0	0	0	0	0	0	0	171
APOLLOGRACHT	PCSV	Baltimore	38	32	19	24	0	0	0	0	0	0	0	0	113
ARCTIC OCEAN	C6T2062	NYC	0	0	1	0	0	0	0	0	0	0	0	0	1
ARCTIC SUN	ELQB8	Anchorage	92	92	97	97	0	0	0	0	0	0	0	0	378
ARGONAUT	KFDV	NYC	18	2	1	0	0	0	0	0	0	0	0	0	21
ARIES HARMONY	3FEY7	Seattle	0	7	5	3	0	0	0	0	0	0	0	0	15
ARTHUR M. ANDERSON	WE4805	Chicago	4	0	0	0	0	0	0	0	0	0	0	0	4
ATLANTIC CARTIER	C6MS4	Norfolk	40	38	29	43	0	0	0	0	0	0	0	0	150
ATLANTIC OCEAN	C6T2064	NYC	60	79	59	57	0	0	0	0	0	0	0	0	255
ATLANTIS	KAQP	New Orleans	0	0	2	4	0	0	0	0	0	0	0	0	6
BARBARA ANDRIE	WTC9407	Chicago	2	0	0	1	0	0	0	0	0	0	0	0	3
BARRINGTON ISLAND	C6QK	Miami	37	14	14	20	0	0	0	0	0	0	0	0	85
BERNARDO QUINTANA A	C6KJ5	New Orleans	70	64	74	50	0	0	0	0	0	0	0	0	258
BLARNEY	WBP4766	Kodiak	1	4	1	1	0	0	0	0	0	0	0	0	7
BLUE GEMINI	3FPA6	Seattle	72	42	76	13	0	0	0	0	0	0	0	0	203
BLUEFIN	WQZ9646	Kodiak	0	0	0	1	0	0	0	0	0	0	0	0	1
BOSPORUS BRIDGE	3FMV3	Oakland	66	36	0	0	0	0	0	0	0	0	0	0	102
BOWFIN	WSX7318	Kodiak	0	0	1	0	0	0	0	0	0	0	0	0	1
BRIGHT STATE	3FMY7	Seattle	30	27	34	29	0	0	0	0	0	0	0	0	120
BRUCE	WWU8	Anchorage	25	33	23	30	0	0	0	0	0	0	0	0	111
BUFFALO SOLDIER	WWXB	Houston	9	24	4	0	0	0	0	0	0	0	0	0	37
BURNS HARBOR	WQZ7049	Chicago	0	0	0	18	0	0	0	0	0	0	0	0	18
CALIFORNIA JUPITER	ELKU8	Long Beach	23	38	7	0	0	0	0	0	0	0	0	0	68
CAPE TEXAS	WSDG	Houston	0	0	4	3	0	0	0	0	0	0	0	0	7

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CAPE VINCENT	KAES	Houston	0	0	0	3	0	0	0	0	0	0	0	0	3
CAPELLA VOYAGER	C6FD4	Baltimore	32	31	10	32	0	0	0	0	0	0	0	0	105
CAPT LES EASON	WTT8587	Kodiak	0	0	2	4	0	0	0	0	0	0	0	0	6
CAPT STEVEN L BENNETT	KAXO	New Orleans	92	109	100	36	0	0	0	0	0	0	0	0	337
CARIBBEAN MERCY	3FFU4	Miami	13	0	0	6	0	0	0	0	0	0	0	0	19
CARNIVAL CONQUEST	3FPQ9	New Orleans	0	1	5	12	0	0	0	0	0	0	0	0	18
CARNIVAL PARADISE	3FOB5	Miami	0	1	0	2	0	0	0	0	0	0	0	0	3
CARNIVAL PRIDE	H3VU	Miami	0	0	2	0	0	0	0	0	0	0	0	0	2
CARNIVAL SPIRIT	3FPR9	Miami	0	3	0	0	0	0	0	0	0	0	0	0	3
CARNIVAL TRIUMPH	C6FN5	Miami	27	30	38	38	0	0	0	0	0	0	0	0	133
CARNIVAL VICTORY	3FFL8	Miami	24	26	29	17	0	0	0	0	0	0	0	0	96
CARSTEN MAERSK	OZYB2	Seattle	51	0	0	0	0	0	0	0	0	0	0	0	51
CASON J. CALLAWAY	WE4879	Chicago	46	0	0	1	0	0	0	0	0	0	0	0	47
CELEBRATION	H3GQ	New Orleans	3	0	0	0	0	0	0	0	0	0	0	0	3
CELTIC SEA	C6RT	Miami	0	0	0	45	0	0	0	0	0	0	0	0	45
CENTURY HIGHWAY #2	3EJB9	Long Beach	23	20	22	17	0	0	0	0	0	0	0	0	82
CGM RENOIR	ELVZ8	Norfolk	0	1	0	0	0	0	0	0	0	0	0	0	1
CHANG-LIN TIEN	C6FE6	Oakland	4	7	0	0	0	0	0	0	0	0	0	0	11
CHARLES ISLAND	C6JT	Miami	38	31	4	3	0	0	0	0	0	0	0	0	76
CHARLOTTE MAERSK	OWLD2	Seattle	0	42	20	0	0	0	0	0	0	0	0	0	62
CHASTINE MAERSK	OZZB2	Seattle	0	0	33	0	0	0	0	0	0	0	0	0	33
CHEMICAL EXPLORER	KRGC	Houston	0	1	0	0	0	0	0	0	0	0	0	0	1
CHEMICAL PIONEER	KAFO	Houston	21	39	34	26	0	0	0	0	0	0	0	0	120
CHESAPEAKE BAY	WMLH	Norfolk	35	24	52	45	0	0	0	0	0	0	0	0	156
CHEVRON ARIZONA	KGBE	Miami	0	5	0	0	0	0	0	0	0	0	0	0	5
CHEVRON WASHINGTON	KFDB	Oakland	0	1	4	8	0	0	0	0	0	0	0	0	13
CHIEF GADAO	WEZD	Oakland	23	19	35	30	0	0	0	0	0	0	0	0	107
CHIQUITA BELGIE	C6KD7	Baltimore	60	46	45	45	0	0	0	0	0	0	0	0	196
CHIQUITA BREMEN	ZCBC5	Miami	16	14	32	15	0	0	0	0	0	0	0	0	77
CHIQUITA DEUTSCHLAND	C6KD8	Baltimore	79	54	59	34	0	0	0	0	0	0	0	0	226
CHIQUITA ITALIA	C6KD5	Baltimore	0	0	5	43	0	0	0	0	0	0	0	0	48
CHIQUITA JEAN	ZCBB7	Jacksonville	0	0	0	5	0	0	0	0	0	0	0	0	5
CHIQUITA NEDERLAND	C6KD6	Baltimore	53	41	55	48	0	0	0	0	0	0	0	0	197
CHIQUITA SCANDINAVIA	C6KD4	Baltimore	52	49	63	54	0	0	0	0	0	0	0	0	218
CHIQUITA SCHWEIZ	C6KD9	Baltimore	56	46	43	45	0	0	0	0	0	0	0	0	190
CLEMENTINE MAERSK	OUQK2	Seattle	0	0	0	1	0	0	0	0	0	0	0	0	1
CLEVELAND	KGXA	Houston	17	38	25	30	0	0	0	0	0	0	0	0	110
COASTAL EXPLORER	WCY3172	Kodiak	0	0	0	5	0	0	0	0	0	0	0	0	5
COASTAL MERCHANT	WCV8696	Seattle	10	0	4	10	0	0	0	0	0	0	0	0	24
COASTAL PILOT	WBP7281	Kodiak	2	0	6	0	0	0	0	0	0	0	0	0	8
COASTAL TRADER	WSL8560	Kodiak	0	4	0	0	0	0	0	0	0	0	0	0	4
COLUMBINE MAERSK	OUHC2	Seattle	4	38	1	0	0	0	0	0	0	0	0	0	43
COLUMBUS CANADA	P3RD8	Norfolk	40	9	3	1	0	0	0	0	0	0	0	0	53
COLUMBUS VICTORIA	P3RF8	Norfolk	58	25	73	83	0	0	0	0	0	0	0	0	239
CONTI MALACA	DGVZ	Norfolk	0	0	13	25	0	0	0	0	0	0	0	0	38
CORAL SEA	C6YW	Miami	38	34	0	0	0	0	0	0	0	0	0	0	72
CORMORANT ARROW	C6IO9	Seattle	0	0	34	46	0	0	0	0	0	0	0	0	80
COSCO NORFOLK	P3ZY6	Norfolk	17	9	0	25	0	0	0	0	0	0	0	0	51
COURIER	KCBK	Houston	5	49	0	0	0	0	0	0	0	0	0	0	54
COURTNEY L	ZCAQ8	Baltimore	53	26	14	18	0	0	0	0	0	0	0	0	111
CSAV BUSAN	ELWZ3	Long Beach	55	35	53	31	0	0	0	0	0	0	0	0	174
CSL CABO	D5XH	Seattle	0	12	20	33	0	0	0	0	0	0	0	0	65
CSX ANCHORAGE	KGTX	Anchorage	60	61	73	69	0	0	0	0	0	0	0	0	263

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CSX CHALLENGER	WZJC	Jacksonville	21	8	12	53	0	0	0	0	0	0	0	0	94
CSX CONSUMER	WCHF	Long Beach	50	40	9	24	0	0	0	0	0	0	0	0	123
CSX DEFENDER	KGJB	Oakland	46	30	49	51	0	0	0	0	0	0	0	0	176
CSX DISCOVERY	WZJD	Jacksonville	58	52	57	53	0	0	0	0	0	0	0	0	220
CSX ENTERPRISE	KRGB	Oakland	57	62	70	27	0	0	0	0	0	0	0	0	216
CSX EXPEDITION	WPGJ	Jacksonville	59	49	85	83	0	0	0	0	0	0	0	0	276
CSX KODIAK	KGTZ	Anchorage	66	52	62	35	0	0	0	0	0	0	0	0	215
CSX PACIFIC	WSRL	Long Beach	54	30	44	55	0	0	0	0	0	0	0	0	183
CSX PATRIOT	KHRF	Oakland	35	41	48	24	0	0	0	0	0	0	0	0	148
CSX RELIANCE	WFLH	Long Beach	81	83	72	70	0	0	0	0	0	0	0	0	306
CSX SPIRIT	WFLG	Oakland	52	53	34	49	0	0	0	0	0	0	0	0	188
CSX TACOMA	KGTY	Anchorage	37	43	64	57	0	0	0	0	0	0	0	0	201
CSX TRADER	KIRH	Oakland	27	15	33	36	0	0	0	0	0	0	0	0	111
CYNTHIA FAGAN	KSDF	Houston	41	31	1	0	0	0	0	0	0	0	0	0	73
DAISHIN MARU	3FPS6	Seattle	85	90	71	62	0	0	0	0	0	0	0	0	308
DEEPWATER MILLENNIUM	3FJA9	Houston	27	16	14	15	0	0	0	0	0	0	0	0	72
DELAWARE BAY	WMLG	Norfolk	32	22	43	35	0	0	0	0	0	0	0	0	132
DENALI	WSVR	Long Beach	36	22	15	17	0	0	0	0	0	0	0	0	90
DIANE H.	WUR7250	Kodiak	0	0	0	1	0	0	0	0	0	0	0	0	1
DIRCH MAERSK	OXQP2	Long Beach	66	21	24	24	0	0	0	0	0	0	0	0	135
DIRECT TUI	ELVZ5	Norfolk	58	64	37	40	0	0	0	0	0	0	0	0	199
DISCOVERER DEEP SEAS	HP9685	New Orleans	20	23	15	35	0	0	0	0	0	0	0	0	93
DISCOVERER ENTERPRISE	3FZQ7	New Orleans	13	3	2	2	0	0	0	0	0	0	0	0	20
DUNCAN ISLAND	C6JS	Miami	67	51	47	44	0	0	0	0	0	0	0	0	209
E.L. BARTLETT	WY6244	Kodiak	1	0	0	0	0	0	0	0	0	0	0	0	1
EDGAR B. SPEER	WQZ9670	Chicago	14	3	3	23	0	0	0	0	0	0	0	0	43
EDWARD OLDENDORFF	ELWP2	Norfolk	0	33	0	28	0	0	0	0	0	0	0	0	61
EDWIN H. GOTT	WXQ4511	Chicago	0	0	0	11	0	0	0	0	0	0	0	0	11
EDYTH L	C6YC	Baltimore	71	47	52	42	0	0	0	0	0	0	0	0	212
EL MORRO	KCGH	Miami	3	0	0	0	0	0	0	0	0	0	0	0	3
EL YUNQUE	WGJT	Jacksonville	6	7	10	28	0	0	0	0	0	0	0	0	51
ELATION	3FOC5	Miami	22	15	0	0	0	0	0	0	0	0	0	0	37
EMPIRE STATE	KKFW	NYC	31	8	0	0	0	0	0	0	0	0	0	0	39
ENDEAVOR	WAUW	NYC	34	31	55	1	0	0	0	0	0	0	0	0	121
ENDURANCE	WAUU	NYC	40	27	29	41	0	0	0	0	0	0	0	0	137
ENIF	9VVI	Houston	18	0	0	0	0	0	0	0	0	0	0	0	18
ENTERPRISE	WAUY	NYC	15	0	0	0	0	0	0	0	0	0	0	0	15
EVER DEVELOP	3FLF8	NYC	0	0	0	3	0	0	0	0	0	0	0	0	3
EVER DIADEM	3FOF8	NYC	10	7	9	5	0	0	0	0	0	0	0	0	31
EVER DYNAMIC	3FUB8	NYC	6	4	8	0	0	0	0	0	0	0	0	0	18
EVER GENERAL	BKHY	Baltimore	15	0	0	0	0	0	0	0	0	0	0	0	15
EVER GOODS	BKHZ	NYC	11	8	2	0	0	0	0	0	0	0	0	0	21
EVER REACH	3FQO4	NYC	53	12	38	14	0	0	0	0	0	0	0	0	117
EVER ROUND	3FQN3	Long Beach	10	0	0	0	0	0	0	0	0	0	0	0	10
EVER ULTRA	3FEJ6	Seattle	0	4	0	0	0	0	0	0	0	0	0	0	4
EVER UNIQUE	3FXQ6	Seattle	10	0	0	6	0	0	0	0	0	0	0	0	16
EVER URANUS	3FCA9	Seattle	0	0	0	6	0	0	0	0	0	0	0	0	6
EVERETT EXPRESS	DPGD	Seattle	32	32	25	30	0	0	0	0	0	0	0	0	119
EWA	WEZM	Long Beach	10	27	21	34	0	0	0	0	0	0	0	0	92
EXPLORER OF THE SEAS	ELWX5	Miami	36	388	430	361	0	0	0	0	0	0	0	0	1215
FASCINATION	C6FM9	Miami	9	7	9	5	0	0	0	0	0	0	0	0	30
FAUST	WRYX	Baltimore	48	52	66	46	0	0	0	0	0	0	0	0	212
FIDELIO	WQVY	Baltimore	52	22	43	56	0	0	0	0	0	0	0	0	173

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
FIGARO	S6PI	Baltimore	58	8	0	0	0	0	0	0	0	0	0	0	66
FRANCES L	C6YE	Baltimore	34	24	19	36	0	0	0	0	0	0	0	0	113
FRANK A. SHRONTZ	C6PZ3	Oakland	27	38	48	53	0	0	0	0	0	0	0	0	166
GALE WIND	WAZ9548	Anchorage	12	3	9	1	0	0	0	0	0	0	0	0	25
GEMINI	V7BW9	Kodiak	17	3	0	0	0	0	0	0	0	0	0	0	20
GERMAN SENATOR	ELPL3	Seattle	0	0	0	1	0	0	0	0	0	0	0	0	1
GLORIOUS SUCCESS	DUHN	Seattle	34	0	0	4	0	0	0	0	0	0	0	0	38
GOLDEN BEAR	NMRY	Oakland	0	0	0	13	0	0	0	0	0	0	0	0	13
GOLDEN NOVA	3FDV6	Seattle	9	21	2	0	0	0	0	0	0	0	0	0	32
GREAT LAND	WFDP	Seattle	121	146	154	70	0	0	0	0	0	0	0	0	491
GREEN DALE	WCZ5238	Jacksonville	14	19	43	7	0	0	0	0	0	0	0	0	83
GREEN LAKE	WDDI	Baltimore	20	0	0	0	0	0	0	0	0	0	0	0	20
GREEN POINT	WCY4148	NYC	54	42	33	30	0	0	0	0	0	0	0	0	159
GUARDIAN	WBO2511	Anchorage	0	0	0	1	0	0	0	0	0	0	0	0	1
GUS W. DARNELL	KCDK	Houston	27	0	0	0	0	0	0	0	0	0	0	0	27
GYPSUM KING	ZCAN2	Baltimore	52	48	33	13	0	0	0	0	0	0	0	0	146
GYR FALCON	WCU6587	Kodiak	2	0	0	0	0	0	0	0	0	0	0	0	2
HADERA	ELBX4	Baltimore	41	28	50	14	0	0	0	0	0	0	0	0	133
HARMONY ACE	H3QA	Jacksonville	24	18	35	73	0	0	0	0	0	0	0	0	150
HATSU EAGLE	ZNZH6	Seattle	13	5	16	7	0	0	0	0	0	0	0	0	41
HATSU ENVOY	VSQL9	Seattle	67	51	70	67	0	0	0	0	0	0	0	0	255
HATSU ETHIC	VQFS4	Seattle	0	0	15	15	0	0	0	0	0	0	0	0	30
HATSU EXCEL	VSXV3	Seattle	48	51	46	11	0	0	0	0	0	0	0	0	156
HENRY SAUSE	WTW9259	Kodiak	0	0	1	4	0	0	0	0	0	0	0	0	5
HOOD ISLAND	C6LU4	Miami	0	0	6	29	0	0	0	0	0	0	0	0	35
HORIZON HAWAII	KIRF	NYC	34	61	64	70	0	0	0	0	0	0	0	0	229
HORIZON PRODUCER	WJBJ	NYC	70	69	83	80	0	0	0	0	0	0	0	0	302
IBIS ARROW	C6CU6	Seattle	0	0	17	23	0	0	0	0	0	0	0	0	40
INDIAN OCEAN	C6T206	NYC	18	20	21	13	0	0	0	0	0	0	0	0	72
INDIANA HARBOR	WXN3191	Chicago	10	0	0	6	0	0	0	0	0	0	0	0	16
INDUSTRIAL CRESCENT	V2UD	Norfolk	0	0	0	1	0	0	0	0	0	0	0	0	1
INDUSTRIAL CHALLENGER	WDHL	Norfolk	13	27	0	0	0	0	0	0	0	0	0	0	40
ISLA DE CEDROS	VRXU2	Seattle	113	54	82	73	0	0	0	0	0	0	0	0	322
ITB BALTIMORE	WXKM	Baltimore	11	29	23	0	0	0	0	0	0	0	0	0	63
ITB GROTON	KMJL	NYC	40	27	15	21	0	0	0	0	0	0	0	0	103
ITB NEW YORK	WVDG	Miami	0	5	15	15	0	0	0	0	0	0	0	0	35
IWANUMA MARU	3ESU8	Seattle	77	107	75	41	0	0	0	0	0	0	0	0	300
J. BENNETT JOHNSTON	C6QE3	Oakland	2	5	0	0	0	0	0	0	0	0	0	0	7
JACKLYN M.	WCV7620	Chicago	7	0	7	13	0	0	0	0	0	0	0	0	27
JAMES R. BARKER	WYP8657	Chicago	1	0	0	16	0	0	0	0	0	0	0	0	17
JOHN G. MUNSON	WE3806	Chicago	6	0	0	0	0	0	0	0	0	0	0	0	6
JOIDES RESOLUTION	D5BC	Norfolk	5	1	0	0	0	0	0	0	0	0	0	0	6
JOSEPH L. BLOCK	WDA2768	Chicago	5	0	0	1	0	0	0	0	0	0	0	0	6
JUBILEE	C6FM7	Long Beach	8	11	13	13	0	0	0	0	0	0	0	0	45
JUDY LITRICO	KCKB	New Orleans	79	37	9	4	0	0	0	0	0	0	0	0	129
JUSTINE FOSS	WYL4978	Kodiak	14	15	14	14	0	0	0	0	0	0	0	0	57
KAPITAN AFANASYEV	UFIL	Seattle	15	10	6	19	0	0	0	0	0	0	0	0	50
KAPITAN KONEV	UAHV	Seattle	0	0	1	8	0	0	0	0	0	0	0	0	9
KAPITAN MASLOV	UBRO	Seattle	0	7	5	0	0	0	0	0	0	0	0	0	12
KAREN ANDRIE	WBS5272	Chicago	0	0	0	3	0	0	0	0	0	0	0	0	3
KAUAI	WSRH	Long Beach	61	55	58	58	0	0	0	0	0	0	0	0	232
KEE LUNG	BHFN	Seattle	50	83	34	45	0	0	0	0	0	0	0	0	212
KEN KOKU	3FMN6	Seattle	0	0	8	5	0	0	0	0	0	0	0	0	13

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
KENAI	WSNB	Anchorage	7	0	0	0	0	0	0	0	0	0	0	0	7
KENNICOTT	WCY2920	Kodiak	24	32	49	52	0	0	0	0	0	0	0	0	157
KILO MOANA	WDA7827	Jacksonville	0	0	0	55	0	0	0	0	0	0	0	0	55
KNUD MAERSK	OYBJ2	NYC	0	0	58	1	0	0	0	0	0	0	0	0	59
KURE	3FGN3	Seattle	7	7	22	24	0	0	0	0	0	0	0	0	60
LECONTE	WZE4270	Kodiak	23	0	0	0	0	0	0	0	0	0	0	0	23
LEYLA KALKAVAN	TCCJ7	Norfolk	0	0	0	32	0	0	0	0	0	0	0	0	32
LIBERTY GRACE	WADN	New Orleans	9	0	0	0	0	0	0	0	0	0	0	0	9
LIBERTY SEA	KPZH	New Orleans	41	0	0	41	0	0	0	0	0	0	0	0	82
LIBERTY SPIRIT	WCPU	New Orleans	0	49	6	13	0	0	0	0	0	0	0	0	68
LIBERTY STAR	WCBP	New Orleans	58	26	67	67	0	0	0	0	0	0	0	0	218
LIBERTY SUN	WCOB	New Orleans	46	29	54	17	0	0	0	0	0	0	0	0	146
LIBERTY WAVE	KRHZ	Houston	0	12	1	0	0	0	0	0	0	0	0	0	13
LIHUE	WTST	Oakland	67	60	56	49	0	0	0	0	0	0	0	0	232
LURLINE	WLVD	Oakland	18	19	28	16	0	0	0	0	0	0	0	0	81
LYKES AMBASSADOR	VSRL9	Houston	21	10	9	12	0	0	0	0	0	0	0	0	52
LYKES DISCOVERER	WGXO	Houston	165	102	162	147	0	0	0	0	0	0	0	0	576
LYKES EAGLE	VSUA7	Houston	10	7	0	0	0	0	0	0	0	0	0	0	17
LYKES EXPLORER	WGLA	Houston	47	24	69	62	0	0	0	0	0	0	0	0	202
LYKES LIBERATOR	WGXN	Houston	33	57	44	36	0	0	0	0	0	0	0	0	170
LYKES MOTIVATOR	WABU	Houston	31	38	49	34	0	0	0	0	0	0	0	0	152
LYKES NAVIGATOR	WGMJ	Houston	48	50	55	42	0	0	0	0	0	0	0	0	195
M/T MONTAUK	WDCJ	New Orleans	29	10	31	16	0	0	0	0	0	0	0	0	86
M/T SUN VOYAGER	C6FD3	Baltimore	37	0	8	0	0	0	0	0	0	0	0	0	45
M/V GEYSIR	WCZ5528	Norfolk	30	1	14	71	0	0	0	0	0	0	0	0	116
MAASDAM	PFRO	Miami	46	30	3	5	0	0	0	0	0	0	0	0	84
MACKINAC BRIDGE	JKES	Seattle	0	31	24	49	0	0	0	0	0	0	0	0	104
MADISON MAERSK	OVJB2	Oakland	0	0	10	27	0	0	0	0	0	0	0	0	37
MAERSK ALASKA	KAKF	Baltimore	29	39	0	0	0	0	0	0	0	0	0	0	68
MAERSK ARIZONA	KAKG	Baltimore	2	0	5	32	0	0	0	0	0	0	0	0	39
MAERSK CONSTELLATION	WRYJ	Houston	28	10	0	0	0	0	0	0	0	0	0	0	38
MAERSK DUBLIN	V2PW3	Long Beach	18	26	22	24	0	0	0	0	0	0	0	0	90
MAERSK SEA	S6CW	Seattle	0	58	3	36	0	0	0	0	0	0	0	0	97
MAERSK SVENDBORG	OZSK2	Seattle	34	42	0	0	0	0	0	0	0	0	0	0	76
MAERSK TAIYO	9VJO	Jacksonville	0	0	25	46	0	0	0	0	0	0	0	0	71
MAERSK WIND	S6TY	Baltimore	20	0	0	0	0	0	0	0	0	0	0	0	20
MAGLEBY MAERSK	OUSH2	NYC	0	7	13	20	0	0	0	0	0	0	0	0	40
MAHIMAHI	WHRN	Oakland	61	49	53	41	0	0	0	0	0	0	0	0	204
MAJESTIC MAERSK	OUJH2	NYC	18	21	16	47	0	0	0	0	0	0	0	0	102
MALOLO	WYH6327	Kodiak	56	19	21	31	0	0	0	0	0	0	0	0	127
MANOA	KDBG	Oakland	30	34	26	36	0	0	0	0	0	0	0	0	126
MARCHEN MAERSK	OWDQ2	Long Beach	29	24	27	13	0	0	0	0	0	0	0	0	93
MAREN MAERSK	OWZU2	Long Beach	22	31	26	29	0	0	0	0	0	0	0	0	108
MARGRETHE MAERSK	OYSN2	Long Beach	31	35	28	8	0	0	0	0	0	0	0	0	102
MARIE MAERSK	OULL2	NYC	24	13	46	25	0	0	0	0	0	0	0	0	108
MARINE CHEMIST	KMCB	Houston	5	0	0	0	0	0	0	0	0	0	0	0	5
MARINE COLUMBIA	KLKZ	Oakland	72	66	67	62	0	0	0	0	0	0	0	0	267
MARION GREEN	PIAN	Norfolk	39	39	27	2	0	0	0	0	0	0	0	0	107
MARIT MAERSK	OZFC2	Miami	23	2	8	15	0	0	0	0	0	0	0	0	48
MATANUSKA	WN4201	Kodiak	0	1	22	1	0	0	0	0	0	0	0	0	24
MATHILDE MAERSK	OUUU2	Long Beach	16	13	8	3	0	0	0	0	0	0	0	0	40
MATSONIA	KHRC	Oakland	22	26	21	19	0	0	0	0	0	0	0	0	88
MAUI	WSLH	Long Beach	40	35	32	48	0	0	0	0	0	0	0	0	155

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
MAURICE EWING	WLDZ	NYC	0	0	0	50	0	0	0	0	0	0	0	0	50
MAYVIEW MAERSK	OWEB2	Oakland	24	8	8	31	0	0	0	0	0	0	0	0	71
MC-KINNEY MAERSK	OUZW2	NYC	5	17	0	0	0	0	0	0	0	0	0	0	22
MEKONG PIONEER	V2JN	Miami	83	76	85	73	0	0	0	0	0	0	0	0	317
MELVILLE	WECB	Long Beach	90	65	64	95	0	0	0	0	0	0	0	0	314
MERCURY	C6SQ6	Miami	0	0	1	0	0	0	0	0	0	0	0	0	1
MESABI MINER	WYQ4356	Chicago	3	0	0	0	0	0	0	0	0	0	0	0	3
METTE MAERSK	OXKT2	Long Beach	29	26	25	25	0	0	0	0	0	0	0	0	105
MICHIGAN	WRB4141	Chicago	0	3	0	1	0	0	0	0	0	0	0	0	4
MIKI HANA	WTW9252	Kodiak	0	0	1	4	0	0	0	0	0	0	0	0	5
MOKIHANA	WNRD	Oakland	64	40	30	47	0	0	0	0	0	0	0	0	181
MOKU PAHU	WBWK	Oakland	6	16	11	6	0	0	0	0	0	0	0	0	39
MOL INNOVATION	9VVP	Oakland	37	15	11	19	0	0	0	0	0	0	0	0	82
MOL THAMES	3EFV8	Norfolk	7	0	27	17	0	0	0	0	0	0	0	0	51
MORMACSUN	WMBK	Houston	0	11	40	50	0	0	0	0	0	0	0	0	101
MOSEL ORE	ELRE5	Norfolk	62	56	11	12	0	0	0	0	0	0	0	0	141
MT VIRGO VOYAGER	C6FG8	New Orleans	53	15	17	53	0	0	0	0	0	0	0	0	138
MUNKEBO MAERSK	OUNI5	NYC	19	12	31	19	0	0	0	0	0	0	0	0	81
MV CONTSHIP ROME	ELVZ6	Norfolk	31	18	43	36	0	0	0	0	0	0	0	0	128
NATHANIEL B. PALMER	WBP3210	Seattle	13	0	0	0	0	0	0	0	0	0	0	0	13
NATOMA	WBB5799	Kodiak	5	0	0	6	0	0	0	0	0	0	0	0	11
NAVAJO	WCT5737	Kodiak	0	0	11	2	0	0	0	0	0	0	0	0	13
NAVIGATOR	WBO3345	Anchorage	44	68	67	76	0	0	0	0	0	0	0	0	255
NEW HORIZON	WKWB	Long Beach	0	48	30	0	0	0	0	0	0	0	0	0	78
NOAA DAVID STARR JORDAN	WTDK	Long Beach	0	2	0	0	0	0	0	0	0	0	0	0	2
NOAA SHIP DELAWARE II	KNBD	NYC	70	91	117	115	0	0	0	0	0	0	0	0	393
NOAA SHIP KA'IMIMOANA	WTEU	Honolulu	69	44	16	70	0	0	0	0	0	0	0	0	199
NOAA SHIP MILLER FREEMAN	WTDM	Seattle	0	129	164	9	0	0	0	0	0	0	0	0	302
NOAA SHIP NANCY FOSTER	WTER	Norfolk	0	0	0	2	0	0	0	0	0	0	0	0	2
NOAA SHIP OREGON II	WTDO	New Orleans	101	84	0	0	0	0	0	0	0	0	0	0	185
NOAA SHIP RAINIER	WTEF	Seattle	1	0	0	0	0	0	0	0	0	0	0	0	1
NOAA SHIP RONALD H BROWN	WTEC	New Orleans	0	22	57	0	0	0	0	0	0	0	0	0	79
NOBEL STAR	KRPP	Houston	32	36	32	17	0	0	0	0	0	0	0	0	117
NOORDAM	PGHT	Miami	1	0	0	0	0	0	0	0	0	0	0	0	1
NORDMAX	P3YS5	Seattle	77	58	46	57	0	0	0	0	0	0	0	0	238
NORTHERN LIGHTS	WFJK	Anchorage	64	4	2	0	0	0	0	0	0	0	0	0	70
NORTHERN SPIRIT	WAQ2746	Kodiak	10	14	20	17	0	0	0	0	0	0	0	0	61
NORTHERN VICTOR	WCZ6534	Kodiak	6	0	0	15	0	0	0	0	0	0	0	0	21
NORWAY	C6CM7	Miami	23	2	0	20	0	0	0	0	0	0	0	0	45
OCEAN RANGER	WAM7635	Anchorage	2	0	0	0	0	0	0	0	0	0	0	0	2
OCEAN SERVICE	WTW9263	Kodiak	7	5	0	6	0	0	0	0	0	0	0	0	18
OGLEBAY NORTON	WAQ3521	Chicago	2	0	0	1	0	0	0	0	0	0	0	0	3
OLEANDER	PJJU	Newark	9	0	0	0	0	0	0	0	0	0	0	0	9
OLYMPIAN HIGHWAY	3FSH4	Seattle	1	27	65	81	0	0	0	0	0	0	0	0	174
OOCL CALIFORNIA	VRWC8	Seattle	50	42	53	51	0	0	0	0	0	0	0	0	196
OOCL FAIR	VRWB8	Long Beach	50	61	52	19	0	0	0	0	0	0	0	0	182
OOCL FIDELITY	VRWG5	Long Beach	38	19	30	35	0	0	0	0	0	0	0	0	122
OOCL FORTUNE	VRWF2	Norfolk	38	6	16	30	0	0	0	0	0	0	0	0	90
OOCL FRIENDSHIP	VRWD3	Long Beach	49	56	49	18	0	0	0	0	0	0	0	0	172

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
OOCL HONG KONG	VRVA5	Oakland	21	20	5	14	0	0	0	0	0	0	0	0	60
OOCL NETHERLANDS	VRVN6	Long Beach	27	27	22	50	0	0	0	0	0	0	0	0	126
ORIANA	GVSN	Miami	8	6	1	4	0	0	0	0	0	0	0	0	19
ORIENTE HOPE	3ETH4	Seattle	11	54	29	29	0	0	0	0	0	0	0	0	123
ORIENTE PRIME	3FOU4	Seattle	21	12	0	0	0	0	0	0	0	0	0	0	33
ORIENTE SHINE	H9AL	Seattle	17	15	13	0	0	0	0	0	0	0	0	0	45
ORIENTE VICTORIA	3FVG8	Seattle	29	15	0	0	0	0	0	0	0	0	0	0	44
ORION VOYAGER	C6MC5	Baltimore	13	12	18	37	0	0	0	0	0	0	0	0	80
OURO DO BRASIL	ELPP9	Baltimore	7	1	21	45	0	0	0	0	0	0	0	0	74
OVERSEAS BOSTON	KRDB	Kodiak	16	8	0	0	0	0	0	0	0	0	0	0	24
OVERSEAS CHICAGO	KBCF	Kodiak	0	1	0	0	0	0	0	0	0	0	0	0	1
OVERSEAS HARRIETTE	WRFJ	Houston	45	36	6	18	0	0	0	0	0	0	0	0	105
OVERSEAS JOYCE	WUQL	Jacksonville	16	24	21	9	0	0	0	0	0	0	0	0	70
OVERSEAS NEW ORLEANS	WFKW	Houston	26	32	37	33	0	0	0	0	0	0	0	0	128
OVERSEAS NEW YORK	WMCK	Kodiak	2	0	0	0	0	0	0	0	0	0	0	0	2
P&O NEDLLOYD MARSEILLE	MYSU5	Seattle	23	2	9	17	0	0	0	0	0	0	0	0	51
P&O NEDLLOYD YANTIAN	ELYD5	Long Beach	28	0	0	0	0	0	0	0	0	0	0	0	28
PACIFIC EXPLORER	V7DN3	Houston	0	0	42	87	0	0	0	0	0	0	0	0	129
PACIFIC FREEDOM	WDJF	Kodiak	0	0	5	9	0	0	0	0	0	0	0	0	14
PANDALUS	WAV7611	Anchorage	0	0	0	1	0	0	0	0	0	0	0	0	1
PARAGON	WDA2311	Kodiak	25	40	32	0	0	0	0	0	0	0	0	0	97
PAUL R. TREGURTHA	WYR4481	Chicago	0	0	0	9	0	0	0	0	0	0	0	0	9
PENANG SENATOR	DQVH	Seattle	37	47	20	41	0	0	0	0	0	0	0	0	145
PHILIP R. CLARKE	WE3592	Chicago	0	0	0	3	0	0	0	0	0	0	0	0	3
PHYLLIS DUNLAP	WDA6552	Kodiak	0	9	3	2	0	0	0	0	0	0	0	0	14
PINE ARROW	C6NZ3	NYC	34	34	43	39	0	0	0	0	0	0	0	0	150
PITTSBURG	ELTQ6	Baltimore	69	60	67	54	0	0	0	0	0	0	0	0	250
POLAR ALASKA	KSBK	Valdez	8	13	9	10	0	0	0	0	0	0	0	0	40
POLAR CALIFORNIA	WMCV	Long Beach	38	25	16	15	0	0	0	0	0	0	0	0	94
POLAR EAGLE	ELPT3	Anchorage	100	75	101	89	0	0	0	0	0	0	0	0	365
POLAR ENDEAVOUR	WCAJ	New Orleans	9	12	18	10	0	0	0	0	0	0	0	0	49
POLAR RESOLUTION	WDJK	New Orleans	21	20	12	20	0	0	0	0	0	0	0	0	73
POLAR TEXAS	KNFD	Valdez	19	14	23	10	0	0	0	0	0	0	0	0	66
PRESIDENT ADAMS	WRYW	Oakland	65	62	74	35	0	0	0	0	0	0	0	0	236
PRESIDENT GRANT	WCY2098	Long Beach	66	50	68	1	0	0	0	0	0	0	0	0	185
PRESIDENT JACKSON	WRYC	Oakland	58	68	65	57	0	0	0	0	0	0	0	0	248
PRESIDENT KENNEDY	WRYE	Oakland	58	44	50	0	0	0	0	0	0	0	0	0	152
PRESIDENT POLK	WRYD	Oakland	32	70	57	45	0	0	0	0	0	0	0	0	204
PRESIDENT TRUMAN	WNDP	Oakland	37	47	66	70	0	0	0	0	0	0	0	0	220
PRESIDENT WILSON	WCY3438	Long Beach	36	20	21	42	0	0	0	0	0	0	0	0	119
PRESQUE ISLE	WZE4928	Chicago	0	0	0	1	0	0	0	0	0	0	0	0	1
PROJECT ARABIA	PJKP	Miami	50	26	0	0	0	0	0	0	0	0	0	0	76
PRUDHOE BAY	KPFD	Long Beach	1	0	0	0	0	0	0	0	0	0	0	0	1
PUSAN SENATOR	DQVG	Seattle	34	29	36	25	0	0	0	0	0	0	0	0	124
QUEENSLAND STAR	MZBM7	Houston	79	15	0	0	0	0	0	0	0	0	0	0	94
R.J. PFEIFFER	WRJP	Long Beach	27	22	28	27	0	0	0	0	0	0	0	0	104
RANI PADMINI	ATSR	Norfolk	0	7	0	0	0	0	0	0	0	0	0	0	7
RAYMOND E. GALVIN	C6FD6	Oakland	18	0	0	0	0	0	0	0	0	0	0	0	18
REBECCA LYNN	WCW7977	Chicago	1	0	0	9	0	0	0	0	0	0	0	0	10
REDFIN	WTP2735	Kodiak	2	0	0	1	0	0	0	0	0	0	0	0	3
REDOUBT	WCG3013	Anchorage	1	0	0	0	0	0	0	0	0	0	0	0	1
RESERVE	WE7207	Chicago	0	0	0	1	0	0	0	0	0	0	0	0	1

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
RESOLUTION	WBR6941	Kodiak	0	0	0	1	0	0	0	0	0	0	0	0	1
RICHARD G MATTHIESEN	WLBV	Jacksonville	10	0	0	0	0	0	0	0	0	0	0	0	10
RICHARD H MATZKE	C6FE5	Oakland	13	5	25	44	0	0	0	0	0	0	0	0	87
ROBERT L.	WTW9264	Kodiak	0	4	7	0	0	0	0	0	0	0	0	0	11
ROGER BLOUGH	WZP8164	Chicago	11	0	1	33	0	0	0	0	0	0	0	0	45
ROGER REVELLE	KAOU	New Orleans	47	24	5	7	0	0	0	0	0	0	0	0	83
ROUGHNECK	WTW9262	Kodiak	0	0	2	6	0	0	0	0	0	0	0	0	8
ROVER	KCBH	Houston	18	6	0	19	0	0	0	0	0	0	0	0	43
RUBIN ARTEMIS	3FAH7	Seattle	31	74	59	44	0	0	0	0	0	0	0	0	208
RUBIN KOBE	DYZM	Seattle	5	16	18	12	0	0	0	0	0	0	0	0	51
RUBIN PEARL	YJQA8	Seattle	117	6	14	0	0	0	0	0	0	0	0	0	137
RUBIN STELLA	3FAP5	Seattle	0	0	3	29	0	0	0	0	0	0	0	0	32
RYNDAM	PHFV	Miami	47	57	48	15	0	0	0	0	0	0	0	0	167
SAG RIVER	WLDF	Houston	7	0	0	0	0	0	0	0	0	0	0	0	7
SALISHAN	WUT4384	Kodiak	0	2	11	11	0	0	0	0	0	0	0	0	24
SAMSON MARINER	WCN3586	Kodiak	13	3	2	4	0	0	0	0	0	0	0	0	22
SANDRA FOSS	WYL4908	Kodiak	0	0	20	20	0	0	0	0	0	0	0	0	40
SANTA BARBARA	ELOT3	Seattle	34	42	47	43	0	0	0	0	0	0	0	0	166
SARATOGA	KL0YL	Kodiak	0	0	20	25	0	0	0	0	0	0	0	0	45
SAUDI ABHA	HZRX	Baltimore	82	46	10	58	0	0	0	0	0	0	0	0	196
SAUDI DIRIYAH	HZZB	Houston	0	0	26	44	0	0	0	0	0	0	0	0	70
SAUDI HOFUF	HZZC	Houston	25	22	41	37	0	0	0	0	0	0	0	0	125
SCHACKENBORG	ZCIH7	Houston	0	0	18	0	0	0	0	0	0	0	0	0	18
SEA MERCHANT	ELQN2	Norfolk	7	50	1	0	0	0	0	0	0	0	0	0	58
SEA VENTURE	WCC7684	Anchorage	14	0	1	0	0	0	0	0	0	0	0	0	15
SEA VICTORY	WCY6777	Anchorage	31	0	0	0	0	0	0	0	0	0	0	0	31
SEA VIKING	WCE8951	Anchorage	7	0	0	0	0	0	0	0	0	0	0	0	7
SEA-LAND CHARGER	V7AY2	Long Beach	16	2	11	1	0	0	0	0	0	0	0	0	30
SEABULK MONTANA	WCW9126	Anchorage	84	91	51	97	0	0	0	0	0	0	0	0	323
SEALAND ACHIEVER	WPKD	Houston	43	39	72	26	0	0	0	0	0	0	0	0	180
SEALAND ARGENTINA	DGVN	Jacksonville	27	3	48	1	0	0	0	0	0	0	0	0	79
SEALAND ATLANTIC	KRLZ	Houston	35	50	38	51	0	0	0	0	0	0	0	0	174
SEALAND CHAMPION	V7AM9	Oakland	49	62	33	65	0	0	0	0	0	0	0	0	209
SEALAND COMET	V7AP3	Norfolk	59	33	55	3	0	0	0	0	0	0	0	0	150
SEALAND COMMITMENT	KRPB	Houston	88	55	73	63	0	0	0	0	0	0	0	0	279
SEALAND DEVELOPER	KHRH	Houston	63	64	39	22	0	0	0	0	0	0	0	0	188
SEALAND EAGLE	V7AZ8	Long Beach	23	16	18	7	0	0	0	0	0	0	0	0	64
SEALAND ENDURANCE	KGJX	Long Beach	29	62	0	0	0	0	0	0	0	0	0	0	91
SEALAND EXPLORER	WGJF	Long Beach	63	51	44	59	0	0	0	0	0	0	0	0	217
SEALAND FLORIDA	KRHX	Houston	37	51	71	28	0	0	0	0	0	0	0	0	187
SEALAND INDEPENDENCE	WGJC	Long Beach	1	0	14	0	0	0	0	0	0	0	0	0	15
SEALAND INNOVATOR	WGKF	Oakland	52	53	47	34	0	0	0	0	0	0	0	0	186
SEALAND INTEGRITY	WPVD	Houston	136	83	125	160	0	0	0	0	0	0	0	0	504
SEALAND INTREPID	9VWZ	Norfolk	0	0	0	49	0	0	0	0	0	0	0	0	49
SEALAND LIBERATOR	KHRP	Oakland	45	50	40	42	0	0	0	0	0	0	0	0	177
SEALAND MERCURY	V7AP6	Oakland	38	39	39	22	0	0	0	0	0	0	0	0	138
SEALAND METEOR	V7AP7	Long Beach	75	49	60	51	0	0	0	0	0	0	0	0	235
SEALAND MOTIVATOR	WAAH	Houston	85	67	21	68	0	0	0	0	0	0	0	0	241
SEALAND NAVIGATOR	WPGK	Long Beach	63	57	47	51	0	0	0	0	0	0	0	0	218
SEALAND PERFORMANCE	KRPD	Houston	38	46	41	52	0	0	0	0	0	0	0	0	177
SEALAND PRIDE	WDA3673	Houston	56	51	63	63	0	0	0	0	0	0	0	0	233
SEALAND QUALITY	KRNJ	Houston	60	42	62	47	0	0	0	0	0	0	0	0	211
SEALAND RACER	V7AP8	Long Beach	25	14	26	32	0	0	0	0	0	0	0	0	97

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
SEALAND VOYAGER	KHRK	Long Beach	13	55	34	49	0	0	0	0	0	0	0	0	151
SELMA KALKAVAN	TCSX	Norfolk	7	56	11	18	0	0	0	0	0	0	0	0	92
SETO BRIDGE	JMQY	Oakland	57	32	21	57	0	0	0	0	0	0	0	0	167
SHEILA MCDEVITT	WDA4069	New Orleans	0	0	55	28	0	0	0	0	0	0	0	0	83
SHIRAOI MARU	3ECM7	Seattle	122	0	1	0	0	0	0	0	0	0	0	0	123
SIDNEY FOSS	WYL5445	Kodiak	0	5	2	25	0	0	0	0	0	0	0	0	32
SINE MAERSK	OZOK2	Seattle	36	1	0	24	0	0	0	0	0	0	0	0	61
SINUK	WCQ8110	Anchorage	0	0	0	95	0	0	0	0	0	0	0	0	95
SIOUX	WBN7617	Anchorage	2	0	0	0	0	0	0	0	0	0	0	0	2
SKAUGRAN	LADB2	Seattle	31	46	52	43	0	0	0	0	0	0	0	0	172
SOL DO BRASIL	ELQQ4	Baltimore	22	48	0	0	0	0	0	0	0	0	0	0	70
SOLAR WING	ELJS7	Jacksonville	98	22	97	82	0	0	0	0	0	0	0	0	299
SOROE MAERSK	OYKJ2	Seattle	31	13	0	25	0	0	0	0	0	0	0	0	69
SOUTHDOWN CHALLENGER	WA4659	Chicago	0	0	0	13	0	0	0	0	0	0	0	0	13
SOVEREIGN MAERSK	OYGA2	Seattle	0	11	48	0	0	0	0	0	0	0	0	0	59
STAR ALABAMA	LAVU4	Baltimore	0	0	21	0	0	0	0	0	0	0	0	0	21
STAR AMERICA	LAVV4	Jacksonville	38	0	24	31	0	0	0	0	0	0	0	0	93
STAR DOVER	LAEP4	Seattle	36	30	0	38	0	0	0	0	0	0	0	0	104
STAR EAGLE	LAWO2	Baltimore	51	87	32	69	0	0	0	0	0	0	0	0	239
STAR EVVIVA	LAHE2	Jacksonville	24	0	18	0	0	0	0	0	0	0	0	0	42
STAR FLORIDA	LAVW4	Houston	61	14	38	39	0	0	0	0	0	0	0	0	152
STAR FRASER	LAVY4	Houston	5	0	4	38	0	0	0	0	0	0	0	0	47
STAR GEIRANGER	LAKQ5	Norfolk	34	20	22	25	0	0	0	0	0	0	0	0	101
STAR GRAN	LADR4	Long Beach	23	6	6	0	0	0	0	0	0	0	0	0	35
STAR GRINDANGER	LAKR5	Norfolk	85	5	44	34	0	0	0	0	0	0	0	0	168
STAR HANSA	LAXP4	Jacksonville	24	0	6	7	0	0	0	0	0	0	0	0	37
STAR HARMONIA	LAGB5	Baltimore	14	32	1	5	0	0	0	0	0	0	0	0	52
STAR HERDLA	LAVD4	Baltimore	31	67	15	36	0	0	0	0	0	0	0	0	149
STAR HIDRA	LAVN4	Baltimore	0	10	62	2	0	0	0	0	0	0	0	0	74
STAR ISMENE	LANT5	Baltimore	0	38	6	42	0	0	0	0	0	0	0	0	86
STAR ISTIND	LAMP5	Houston	51	43	35	33	0	0	0	0	0	0	0	0	162
STATENDAM	PHSG	Miami	33	7	0	7	0	0	0	0	0	0	0	0	47
STEWART J. CORT	WYZ3931	Chicago	0	0	0	17	0	0	0	0	0	0	0	0	17
STIMSON	WCY2270	Kodiak	0	0	20	19	0	0	0	0	0	0	0	0	39
STRONG PATRIOT	WCZ8589	Norfolk	5	1	18	17	0	0	0	0	0	0	0	0	41
STRONG VIRGINIAN	KSPH	Oakland	47	68	78	86	0	0	0	0	0	0	0	0	279
SVEND MAERSK	OYJS2	Seattle	19	20	0	21	0	0	0	0	0	0	0	0	60
TAI HE	BOAB	Long Beach	35	9	0	0	0	0	0	0	0	0	0	0	44
TAKU	WI9491	Kodiak	20	10	5	0	0	0	0	0	0	0	0	0	35
TALISMAN	LAOW5	Jacksonville	17	6	0	28	0	0	0	0	0	0	0	0	51
TAMESIS	LAOL5	Norfolk	34	3	20	0	0	0	0	0	0	0	0	0	57
TAMPA	LMWO3	Long Beach	34	4	0	0	0	0	0	0	0	0	0	0	38
TAN'ERLIQ	WCY8497	Anchorage	1	0	0	0	0	0	0	0	0	0	0	0	1
TANABATA	WCZ5535	Baltimore	45	28	24	33	0	0	0	0	0	0	0	0	130
TAUSALA SAMOA	V2FA2	Long Beach	0	0	1	0	0	0	0	0	0	0	0	0	1
TELLUS	WRYG	Baltimore	33	4	61	0	0	0	0	0	0	0	0	0	98
THOMAS G. THOMPSON	KTDQ	Seattle	0	6	17	46	0	0	0	0	0	0	0	0	69
TITAN	WAW9232	Kodiak	14	7	0	0	0	0	0	0	0	0	0	0	21
TMM CAMPECHE	VSXC9	Houston	35	30	21	16	0	0	0	0	0	0	0	0	102
TMM TABASCO	VSUA5	Houston	5	4	0	0	0	0	0	0	0	0	0	0	9
TONSINA	KJDG	Kodiak	24	19	23	8	0	0	0	0	0	0	0	0	74
TOWER BRIDGE	ELJL3	Long Beach	0	1	1	0	0	0	0	0	0	0	0	0	2
TREIN MAERSK	MSQQ8	Baltimore	24	0	0	10	0	0	0	0	0	0	0	0	34

Ship Name	Call	Port	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TRIDENT	WCZ2913	Kodiak	0	2	5	8	0	0	0	0	0	0	0	0	15
TROJAN STAR	C6OD7	Baltimore	42	13	69	64	0	0	0	0	0	0	0	0	188
TROPIC LURE	J8PD	Miami	1	0	1	0	0	0	0	0	0	0	0	0	2
TUSTUMENA	WNGW	Kodiak	0	0	0	9	0	0	0	0	0	0	0	0	9
TYCOM RELIANCE	V7CZ2	Seattle	0	0	0	27	0	0	0	0	0	0	0	0	27
TYONEK	WMH8	Anchorage	13	10	12	11	0	0	0	0	0	0	0	0	46
UNITED SPIRIT	ELYB2	Seattle	34	32	31	46	0	0	0	0	0	0	0	0	143
USCGC ACUSHNET WMEC 167	NNHA	Kodiak	2	0	0	0	0	0	0	0	0	0	0	0	2
USCGC ALEX HALEY	NZPO	Kodiak	0	1	0	0	0	0	0	0	0	0	0	0	1
USCGC FIREBUSH WLB 393	NODL	Kodiak	0	0	1	0	0	0	0	0	0	0	0	0	1
USCGC HEALY WAGB-20	NEPP	Seattle	123	54	83	3	0	0	0	0	0	0	0	0	263
USCGC POLAR SEA WAGB 1	NRUO	Seattle	83	86	78	78	0	0	0	0	0	0	0	0	325
USCGC SPAR	NJAR	Kodiak	0	0	0	1	0	0	0	0	0	0	0	0	1
USNS 1ST LT. HARRY L. MA	NDFH	Jacksonville	13	0	0	0	0	0	0	0	0	0	0	0	13
VIKING STAR	WAS4138	Kodiak	8	3	0	1	0	0	0	0	0	0	0	0	12
VLADIVOSTOK	UBXP	Seattle	71	56	63	48	0	0	0	0	0	0	0	0	238
WECOMA	WSD7079	Seattle	59	69	36	61	0	0	0	0	0	0	0	0	225
WESTWARD VENTURE	KHJB	Seattle	0	19	27	55	0	0	0	0	0	0	0	0	101
WESTWOOD ANETTE	C6QO9	Seattle	16	6	16	24	0	0	0	0	0	0	0	0	62
WESTWOOD BORG	LAON4	Seattle	82	43	88	48	0	0	0	0	0	0	0	0	261
WESTWOOD BREEZE	LAOT4	Seattle	47	63	43	44	0	0	0	0	0	0	0	0	197
WESTWOOD COLUMBIA	C6SI4	Seattle	0	0	37	31	0	0	0	0	0	0	0	0	68
WESTWOOD JAGO	H9IL	Seattle	14	20	0	0	0	0	0	0	0	0	0	0	34
WESTWOOD MARIANNE	C6QD3	Seattle	50	48	67	49	0	0	0	0	0	0	0	0	214
WESTWOOD RAINIER	C6SI3	Seattle	78	44	41	36	0	0	0	0	0	0	0	0	199
WILFRED SYKES	WDA2769	Chicago	0	0	0	3	0	0	0	0	0	0	0	0	3
WILSON	WNPD	New Orleans	48	44	0	0	0	0	0	0	0	0	0	0	92
WOLDSTAD	WCY2271	Kodiak	0	0	24	37	0	0	0	0	0	0	0	0	61
WORLD SPIRIT	ELWG7	Seattle	42	34	44	45	0	0	0	0	0	0	0	0	165
ZENITH	WBV3237	Kodiak	1	0	1	0	0	0	0	0	0	0	0	0	2
ZIM AMERICA	4XGR	NYC	47	0	0	15	0	0	0	0	0	0	0	0	62
ZIM ASIA	4XFB	New Orleans	25	23	30	35	0	0	0	0	0	0	0	0	113
ZIM ISRAEL	4XGX	New Orleans	3	2	13	72	0	0	0	0	0	0	0	0	90
ZIM ITALIA	4XGT	New Orleans	38	0	13	37	0	0	0	0	0	0	0	0	88

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total Ships: 501	Totals:	13362	11451	1183	11739	0	0	0	0	0	0	0	0	48388

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